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ABSTRACT

The 24 activities in the Outdoor Biology Instructional Strategies (OBIS) Trial Edition Set II use living organisms such as crabs, birds, crayfish, lichens, and insects to investigate biological interrelationships, organism behavior, and species density to promote greater environmental and sensory awareness. The activities, designed primarily for groups of children ages 10 to 15, focus on terrestrial, beach, freshwater, marine, woodland, and other habitats. Light and its effect on animal behavior, study of intertidal plant and animal colonies, hibernation site study, comparison of insects in lawn areas and weedy areas, a simulated oil spill, investigation of sea movements and currents, and a series of environmental games are among the specific activities. Each is presented in a folio with an introduction, list of materials, action, discussion, and follow up. There are three additional folios: (1) an introduction to OBIS: (2) a "Leader's Survival Kit", with suggestions for the combination of the Set I and II activities into various learning modules organized by biological or environmental concept, skill, or habitat; and (3) an OBIS Tool Box, containing Equipment and Technique Cards with instructions for the construction and use of inexpensive equipment, such as bird feeders and tide stakes. (SB)

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ED174366

OUTDOOR
BIOLOGY
INSTRUCTIONAL
STRATEGIES
TRIAL EDITION

SET II

No. 901 G.

RC 011195

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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EDUCATION

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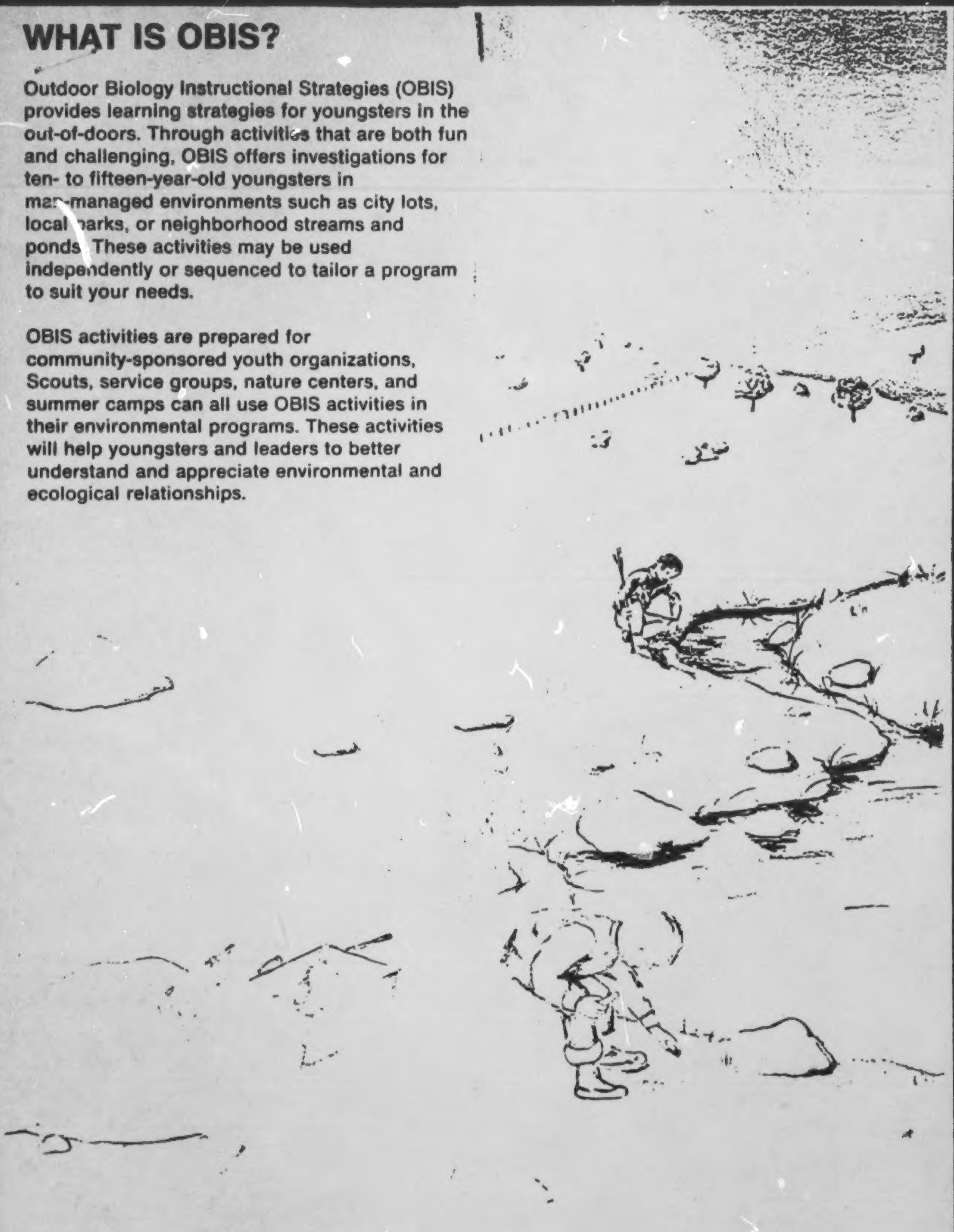
WHAT IS OBIS?

Outdoor Biology Instructional Strategies (OBIS) provides learning strategies for youngsters in the out-of-doors. Through activities that are both fun and challenging, OBIS offers investigations for ten- to fifteen-year-old youngsters in man-managed environments such as city lots, local parks, or neighborhood streams and ponds. These activities may be used independently or sequenced to tailor a program to suit your needs.

OBIS activities are prepared for community-sponsored youth organizations. Scouts, service groups, nature centers, and summer camps can all use OBIS activities in their environmental programs. These activities will help youngsters and leaders to better understand and appreciate environmental and ecological relationships.



WHY OBIS?

Our relationship with our environment has reached a crisis. For too long we have considered ourselves independent of nature; we have taken what we wanted and changed what did not suit our purposes. The environment withstood our carelessness for centuries because land was plentiful and our population was small. As man prospered, medicine and technology produced a greater chance of survival; and as our population increased, we demanded more of our earth's natural resources. Unfortunately, we remained uninformed or indifferent to the effects of our demands on plants, animals, soil, air, and water. We have now reached the point where we can no longer ignore the ecosystem of which we are a part. We now realize that we are exhausting the available supply of many natural resources.

If we are to make intelligent decisions regarding the future of our ecosystem, we must have a thorough understanding of basic biological relationships. The ecological understanding that grows with each OBIS experience will provide a base that youngsters can use in the future to more intelligently consider environmental and ecological decisions. This is the long-term goal of OBIS.

IT'S A BIOLOGICAL WORLD

We are part of the **ecosystem**, which includes living organisms and the non-living environment. Plants and animals, and their interactions with each other and their environment, all affect the ecosystem in some way. The study of these interactions between organisms and their environments is call **ecology.**

Food Chain

Energy for the operation of the ecosystem comes from the sun. Through **photosynthesis,** plants transform the sun's light energy into food energy. Animals cannot make food; they must obtain their food by eating plants or other animals that eat plants. The energy in the food is transferred from plants to plant eaters and then to animal eaters. This transfer is called a **food chain.** When organisms die, their bodies may be eaten by scavengers as diverse as worms and vultures.

Natural Recycling

Plant and animal tissues not eaten by scavengers are consumed by fungi, molds, bacteria, and many kinds of small animals. In the process of obtaining food, these organisms decompose the dead organic matter and eventually reduce it to minerals, water, and carbon dioxide. These materials, returned to the earth, water, and atmosphere, can then be used again by plants to produce food.

Community

Each group of organisms of the same kind that lives and reproduces in a particular area is a **population.** Populations of plants, of plant eaters, of scavengers, and of molds and bacteria live together and depend on each other for food and protection. Such a combination of interdependent populations is called a **community.**

Communities differ depending on their locations. A pond community lives in a pond and consists of different kinds of plants and animals adapted for living in a pond. Oceans, tidepools, lakes, streams, prairies, deserts, and forests all represent communities that differ according to the physical surroundings (**environment**) in which they live, and the populations of plants and animals that make up the community. The lawn that surrounds your house is a community as is the city park or vacant lot. You do not have to travel long distances into the "wilds" to find natural communities.

Life Cycle

Every species must reproduce in order to perpetuate its kind. The process by which an organism comes into being, grows and matures, and produces eggs, seeds, or their equivalent, which in turn become young organisms to repeat the pattern, is called the **life cycle.** Some life cycles are simple; some complex. Some life cycles are short, as in the case of a mosquito which may go through its life cycle in a matter of a few days, while others are long, as in the case of some trees that may take years to mature sufficiently to reproduce.

Adaptation

Within the ecosystem there are other organizing concepts and interactions that are universal wherever there is life. **Adaptations** are special features or behaviors that improve an organism's chances of surviving and reproducing in a particular environment. Some animals display color adaptations that allow them to blend into their surroundings, thus avoiding capture. Other adaptations improve the ability of plants and animals to secure food, reproduce, move through their habitat, and defend themselves. The adaptations that an organism possesses enable it to survive in certain environments. An animal that is adapted to extract oxygen from water, has fins for maneuvering, and can tolerate relatively warm water, might be expected to live in a shallow pond habitat. A **habitat** is the place where an organism normally lives and where you would ordinarily go to find it. A plant that can withstand high temperatures and low moisture might be found in a desert habitat.

If a habitat undergoes a radical change as a result of natural catastrophe (flood, fire, landslide, drought) or the intervention of man (land clearing, swamp draining, construction), the new environmental conditions may no longer support the varieties of life that were previously present. Some plants and animals that existed in the old environment may already have adaptations for the emerging environment, and may flourish. Organisms previously unable to live in a certain habitat may now colonize it because the environment of that habitat has changed. These first colonizers may not be adapted to compete with some of the organisms that follow later, may fail, and therefore may be replaced by still other organisms.

Man

One organism that influences every community is man. The advanced abilities of man's brain have contributed to technological advances that enable him to survive in a wider range of environments than other organisms and to gain dominance over many other life forms. With man's special abilities, however, he must assume responsibility for the consequences of his actions.

It is clear that the time has come for worldwide adoption of sensible management practices which can come only after an understanding of the ecosystem. OBIS provides one avenue for young people to approach this understanding.

OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES

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Outdoor Biology
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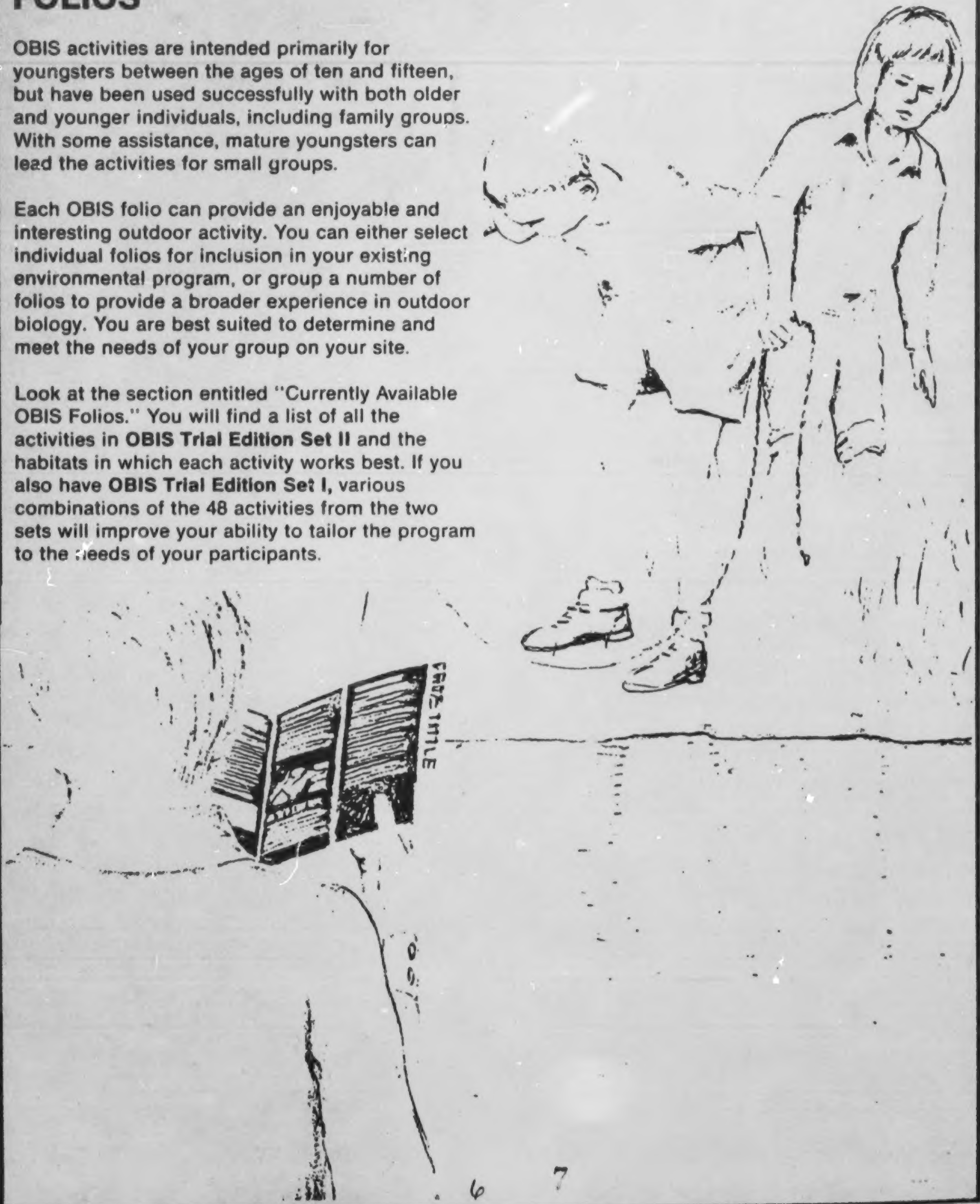
USING THE OBIS FOLIOS

OBIS activities are intended primarily for youngsters between the ages of ten and fifteen, but have been used successfully with both older and younger individuals, including family groups. With some assistance, mature youngsters can lead the activities for small groups.

Each OBIS folio can provide an enjoyable and interesting outdoor activity. You can either select individual folios for inclusion in your existing environmental program, or group a number of folios to provide a broader experience in outdoor biology. You are best suited to determine and meet the needs of your group on your site.

Look at the section entitled "Currently Available OBIS Folios." You will find a list of all the activities in **OBIS Trial Edition Set II** and the habitats in which each activity works best. If you also have **OBIS Trial Edition Set I,** various combinations of the 48 activities from the two sets will improve your ability to tailor the program to the needs of your participants.



CURRENTLY AVAILABLE OBIS FOLIOS

OBIS TRIAL EDITION SET I

Adaptation – Predator-Prey (All habitats)
Animal Movement in Water (Aquatic habitats)
Animals in a Grassland (Lawns, meadows, and fields)
Attention! (All habitats)
Bean Bugs (Terrestrial habitats)
Great Streamboat Race (Streams)
Habitat Sun Prints (All habitats)
Habitats of the Pond (Ponds and lakes)
How Many Organisms Live Here? (Ponds and lakes)
Invent an Animal (All habitats)
Invent a Plant (All habitats)
Mapping a Study Site (All habitats)
Moisture Makers (Terrestrial habitats)
Natural Recycling in Soil (Terrestrial habitats)
Natural Recycling in Water (Aquatic habitats)
Out of Control (Lawn)
Plant Hunt (Terrestrial habitats)
Plants Around a Building (Building sites)
Seed Dispersal (All habitats)
Sticklers (Terrestrial habitats)
Terrestrial Hi-Lo Hunt (Terrestrial habitats)
Water Holes to Mini-Ponds (All habitats)
What Lives Here? (Aquatic habitats)
Who Goes There? (Terrestrial habitats)

THE OBIS TRAIL MODULE

Trail Impact Study
Cardiac Hill
Hold a Hill
Trail Construction

OBIS TRIAL EDITION SET II

A Better Fly Trap (Terrestrial habitats)
Animal Anti-Freeze (Cold terrestrial habitats)
Animal Diversity (Terrestrial habitats)
Attract a Fish (Freshwater habitats)
Beach Zonation (Marine habitats)
Birdfeeder (Terrestrial habitats)
Crawdad Grab (Marine or freshwater habitats)
Flocking to Food (Marsh or beach habitats)
Food Chain Game (Lawn or field habitats)
Gaming in the Outdoors (Terrestrial habitats)
Hopper Circus (Beach or field habitats)
Lichen Looking (Terrestrial habitats)
Litter Critters (Woodland habitats)
Metric Capers (Anywhere)
OBIS Oil Spill (Marine or freshwater habitats)
Plant Patterns (Terrestrial habitats)
Rock Pioneers (Rocky beach habitats)
Roots and Shoots (Terrestrial habitats)
Seas in Motion (Sandy beach habitats)
Sensory Hi-Lo Hunt (Terrestrial habitats)
Sound Off! (Lawn or field habitats)
The Old White Sheet Trick (Terrestrial habitats, at night)
Too Many Mosquitoes (Freshwater pond habitats)
Water Breathers (Marine or freshwater habitats)

ACA/OBIS CAMP KIT FOLIOS

Adaptation – Predator-Prey (All habitats)
Animal Diversity (Terrestrial habitats)
Animal Movement in Water (Aquatic habitats)
Attention! (All habitats)
Attract a Fish (Freshwater habitats)
Food Chain Game (Lawn or field habitats)
Gaming in the Outdoors (Terrestrial habitats)
Great Streamboat Race (Streams)
Habitat Sun Prints (All habitats)
Habitats of the Pond (Ponds and lakes)
Hopper Circus (Beach or field habitats)
How Many Organisms Live Here? (Ponds and lakes)
Invent an Animal (All habitats)
Invent a Plant (All habitats)
Lichen Looking (Terrestrial habitats)
Litter Critters (Woodland habitats)
Mapping a Study Site (All habitats)
OBIS Oil Spill (Marine or freshwater habitats)
Seed Dispersal (All habitats)
Sensory Hi-Lo Hunt (Terrestrial habitats)
Sound Off! (Lawn or field habitats)
The Old White Sheet Trick (Terrestrial habitats, at night)
Water Breathers (Marine or freshwater habitats)
Who Goes There? (Terrestrial habitats)

The folios included in this camp kit were not revised for this special printing. Some of the folio titles suggested in the **WHAT TO DO NEXT** sections will not necessarily be found in this selection.

OBIS MODULES

The OBIS folios may be combined to produce concept packages, skill units, environment-oriented clusters, and many other schemes according to the needs of the children or the judgment of the leader. Any such grouping is often referred to as a **module.**

The OBIS folios in this packet have been selected to form four ACA/OBIS modules. The modules are consistent with the four basic areas of understanding identified by the ACA Camp Ecologist Training Program. Refer to the "ACA/OBIS CAMP KIT" card in this packet for suggested folios for each module.

ORDERING ADDITIONAL MATERIALS

OBIS Trial Editions Set I and **Set II,** plus **The OBIS Trail Module,** are available from the Lawrence Hall of Science. See the "OBIS Order Form" in the *OBIS Toolbox* folio. Also see the "January 1976 Equipment Order Form" in the same folio if you wish to order equipment.

SAFETY

The safety of your group is a prime consideration. In order to assure safety, OBIS designs equipment and procedures to be as safe as possible. In addition, OBIS recommends that leaders organize a "Buddy Safety System" when participants explore any aquatic or other potentially hazardous site.

The buddy safety system is designed so that no participant will ever be far from assistance should it be needed. Group members choose a "buddy" they would like to work with. For an odd-numbered group, organize one team of three buddies. When the youngsters are paired off, tell them that each individual is responsible at all times for the whereabouts and safety of his buddy. A participant should never leave his buddy unless his own safety is threatened. In the event of an accident to one buddy, the other should render assistance and call for help.

Avoid sites with obvious hazards such as steep banks and slide areas. Try to find a site with gently sloping banks for easy water access and unobstructed vision for easy supervision.

CONSERVATION — TAKE 'EM BACK ALIVE

Your youngsters should understand that no organisms should be permanently removed from their habitats. OBIS users collect organisms temporarily for observation and investigation, but all should be returned to the exact place they were found. (Leaf samples are an occasional exception.) The overall impact of your group on an activity site should be minimal. Setting some rules of procedure would emphasize respect for the activity-site environment.

SITE SELECTION

Make sure your selected site is large enough for everyone to investigate without interference, but small enough to allow easy supervision of the group. Site boundaries should be clearly marked and the participants kept within the boundaries. An area fifty meters square is ample for most activities, while some activities can take place in even smaller sites.

Secure permission to use a site in advance if such permission is required. Familiarize yourself with any rules or procedures that apply to the use of the site. Some sites, particularly public nature areas, are protected by strict rules, particularly rules regarding interference with living organisms. Make sure the youngsters understand and follow the rules.

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EQUIPMENT AND TECHNIQUE CARDS

You will find an assortment of equipment and technique cards inserted in this folio. These cards give you instructions for building and using various pieces of equipment required for certain activities. A few of these cards may be used in more than one activity. Additional copies can be made of any of the cards. Listed below are the activities that require these equipment and technique cards.

Animal Diversity
Sweepnet

Beach Zonation
Determining High Tide Level
Use of the Tide Table

Birdfeeder
Basic Birdfeeder
Bird Model
Eyespot

Flocking to Food
Use of the Tide Table

Gaming in the Outdoors
Crayon Rubbings
Ink Prints
Sun Prints

Litter Critters
Litter Shaker

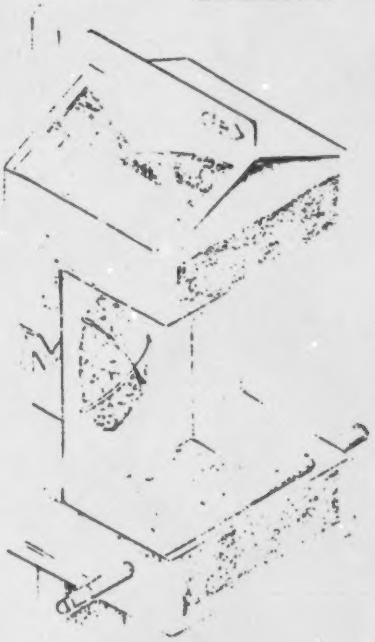
Metric Capers
Measuring Length
Measuring Volume

OBIS Oil Spill
Popcorn Slinger

Rock Pioneers
Use of the Tide Table

Seas in Motion
Sand Stakes
Tide Stakes
Water Balloons
Marked Shells
Dye Markers
Tossing Cups
Use of the Tide Table

LITTER CRITTER WHEEL



BASIC EQUIPMENT, AIDS, GUIDES

Data Board

Many OBIS activities call for the use of a **data board.** This board serves as a portable blackboard, record board, map, and all-purpose data organizer. Because your participants probably will not have a desk or locker for storage of records from one investigation to the next, a data board allows you to maintain a continuing record. The data board relieves youngsters of the burden of pencils and notebooks. Important terms can be easily viewed by all group members, and field observations are conveniently displayed in one place for group consideration.

Making a Data Board*

1. You will need a piece of thick cardboard, masonite, or fiberboard for a data board. A good size is 80 cm x 60 cm.

2. Attach paper sheets (butcher or other) to the board.

3. Crayons or felt-tip markers are good for recording data because they leave broad marks and come in a variety of colors, allowing for easy color coding.

Comparison of Data

Some OBIS activities require comparisons of data collected on different occasions, but at the same activity site. It is often convenient to record the data on plastic overlays on a data-board map of the site. A good source of overlay plastic is inexpensive plastic dropcloth material sold at paint stores and discount variety stores (wax paper also works well). Data can be recorded on one overlay during one investigation, and on others at subsequent investigations. For comparison of data, simply stack up the overlays.

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*As an alternative, you can use a large sketch pad or small blackboard.

Lawn and Pond Organism Guides

These guides are designed for quick, easy identification of some of the most commonly encountered lawn and pond organisms. Only those organisms readily observed by the unaided eye or by means of a simple magnifying lens have been included.

To use the guides, simply flip through the pages until you come to a drawing that corresponds to the organism you wish to identify. Because the drawings are black and white and do not move, be sure to explain to your group that the organisms located will not exactly match the guide's drawings. The investigator should look for the drawing that most closely resembles his organism.

Action Cards

Many folios contain activity cards, which must be duplicated in order to provide sufficient copies for the youngsters. These cards, and in some cases the equipment cards, may be duplicated on any copying machine and the master sheet saved for future activities. We suggest you do the copying before the activity period and, in the case of summer camps or wilderness situations, before leaving the office machine behind.

Each sheet of action cards contains four cards. Cut the copies apart and give one card to each participant. In some cases, we provide blank cards which allow you to create additional challenges that are suited to your particular environment.

Equipment Card

Animal Diversity

Outdoor Biology Instructional Strategies

SWEEPNET

MATERIALS:

1 wire coat hanger

1 stick (approximately 1 meter long) for your net handle

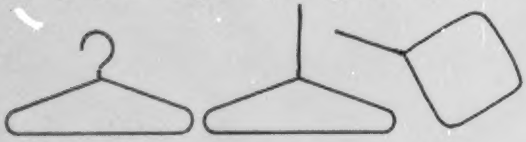
1 piece of cheese cloth or netting for the net bag (1 square meter)

1 needle and thread for sewing (or a sewing machine)

1 piece of tape or wire to attach net to handle

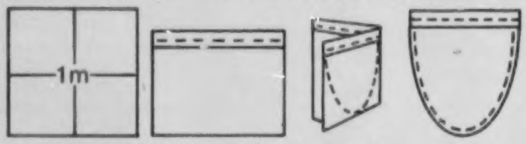
1. Preparing the hoop.

Take a wire coat hanger, straighten the hook, and pull the hanger into a square:



2. Preparing the bag.

Your net should be approximately one meter in circumference at the top, tapering down to a point. A sewing machine speeds up construction, but older kids can hand sew the nets if sufficient time is provided. Sew like this:



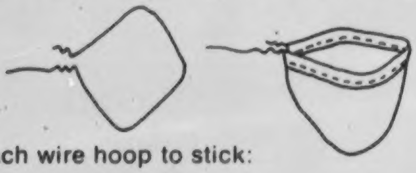
Fold one edge down and sew

Fold square in half and sew

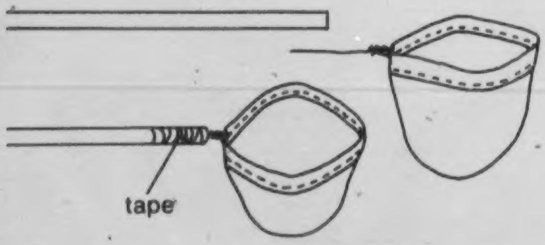
Cut off excess

3. Assembling the net.

Open the wire square and thread on the net:



Attach wire hoop to stick:

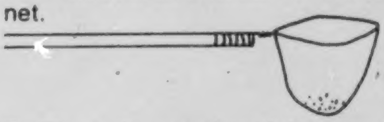


4. Using a sweepnet.

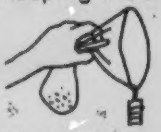
While a sweepnet can be used to pursue and capture an animal that has caught your eye, this is not the most efficient method of use. A sweepnet is best used as a random sampling tool. You walk at moderate speed across the grassy area, sweeping the net back and forth, in pendulum fashion, in front of you. The net should just brush across the top of the grass. The idea is to sweep any animals that are buzzing around in front of you into the nets, so you must turn the net in your hand to capture animals on both right and left swings of the net. After you have made fifteen to thirty swings of the net, make a quick swing around your head to concentrate the animals at the bottom of the net, and grab the end of the net in your hand to keep the catch from escaping.

How to transfer animals from net to observation bag:

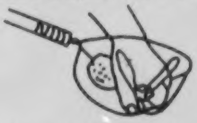
A. Concentrate animals in the bottom of the net.



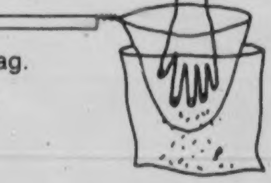
B. Pinch the net closed, keeping the animals in the bottom of the net.



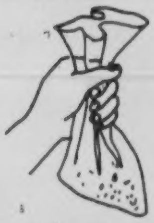
C. Turn net inside out while holding animals.



D. Place net in plastic bag, release and shake animals into the bag.



E. Grab top of bag.



F. Twist the top a couple of times and tuck the top under your belt or into an open pocket while you continue to sweep.

Equipment Card *Birdfeeder*
BASIC BIRDFEEDER

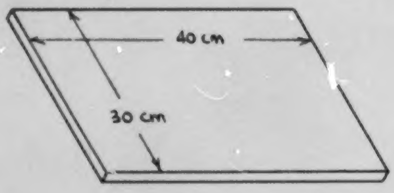
Outdoor Biology Instructional Strategies

MATERIALS:

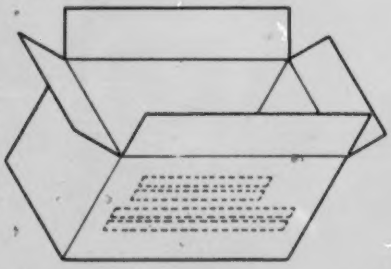
- 1 piece of wood (30 cm x 40 cm and ¼" to 1" thick)
- 1 stiff-cardboard box (at least 40 cm on one side)
- 20 tacks
- 1 stake (1.5 m in length)
- 1 hammer and a few large nails

To build your basic birdfeeder:

1. The platform can be of ¼" to 1" wood.



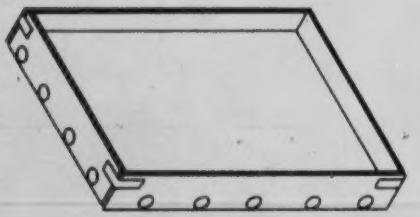
2. Cut edging (to prevent seed from spilling) from a stiff cardboard box.



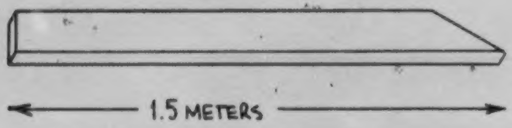
2 30 cm x 3 cm strips

2 40 cm x 3 cm strips

3. Tack the edging to the platform and tape the corners together.

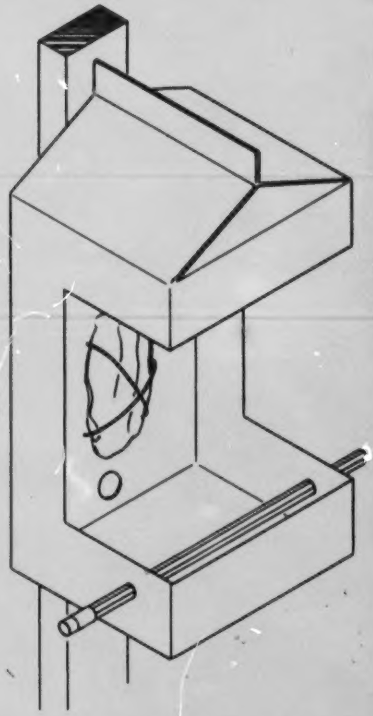


4. Pound the stake firmly into the ground. Then nail the platform to the stake.



FUN FEEDERS TO TRY

MILK CARTON

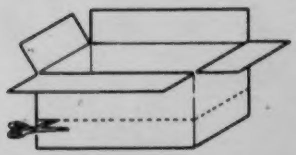


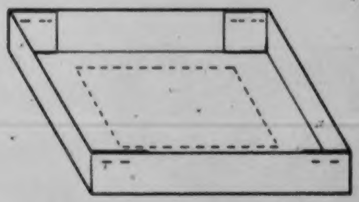
Tie suet to back of milk carton by pulling string through milk carton and tying around the stake.

Thumbtack milk carton to stake.

CARDBOARD BOX

Cut the cardboard box.





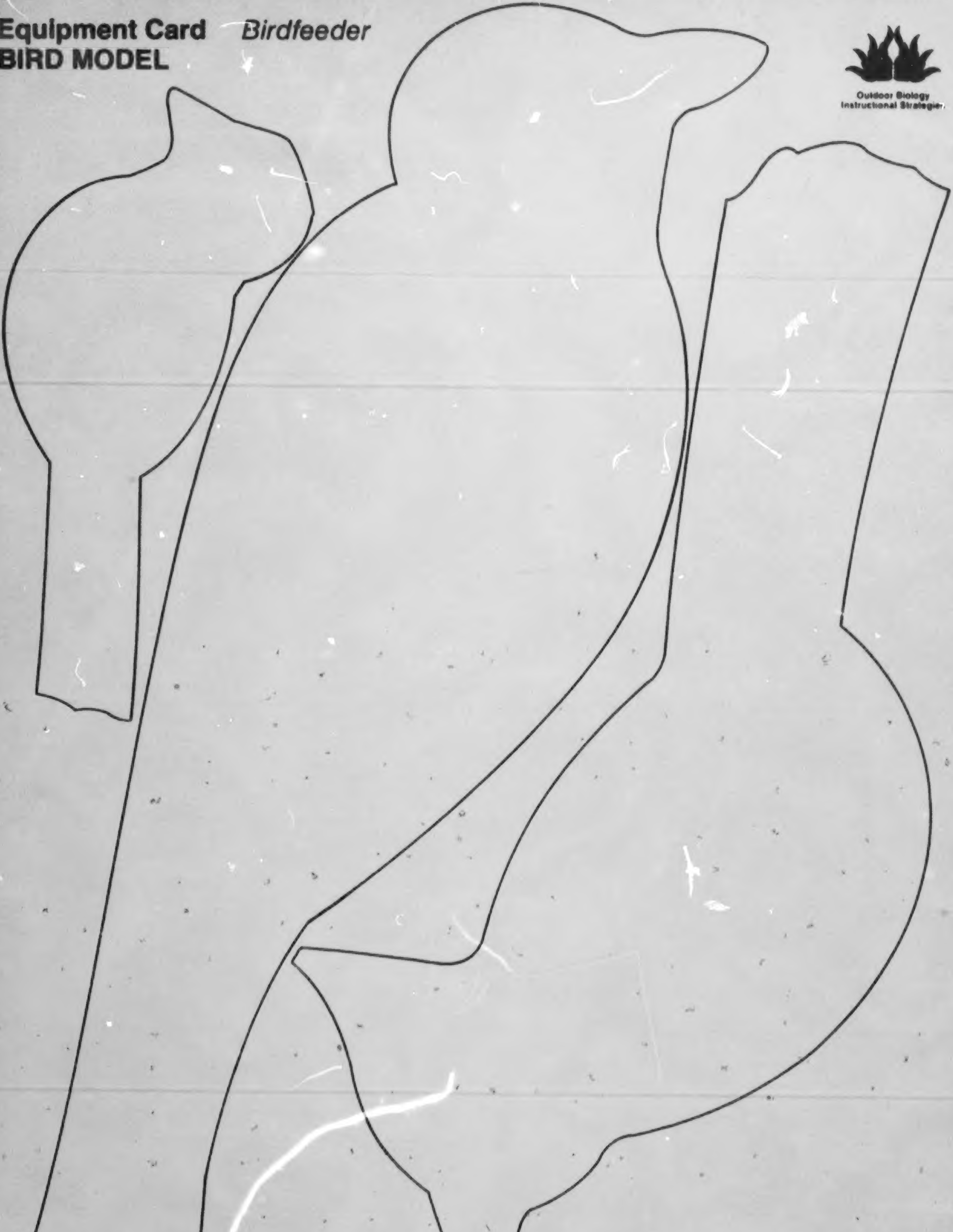
large wood block glued to bottom for strength

nail platform to stake

Equipment Card *Birdfeeder*

BIRD MODEL

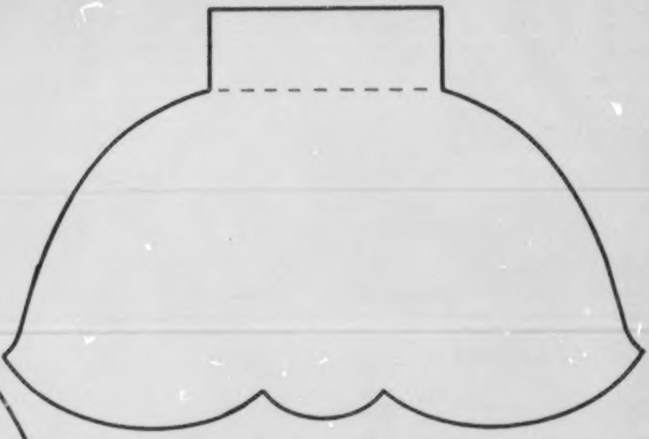
Outdoor Biology Instructional Strategies

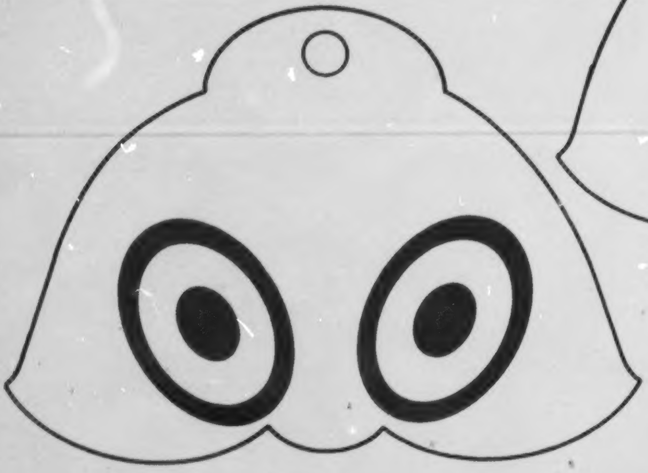


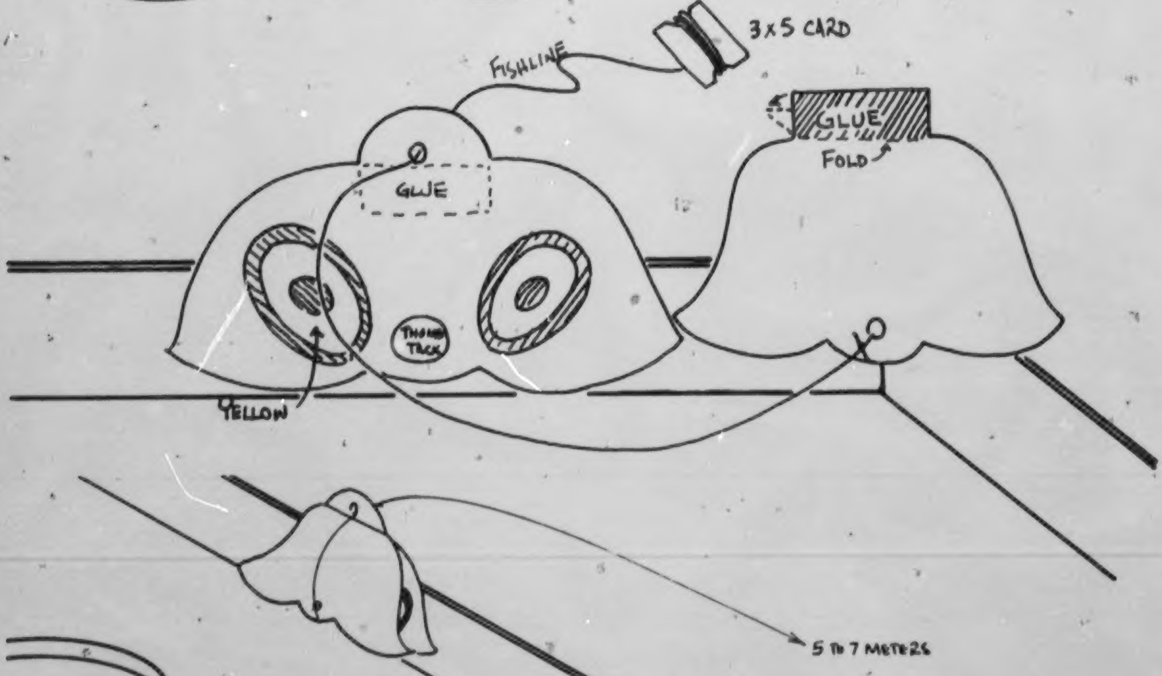
Equipment Card
EYESPOT

Birdfeeder

Outdoo[illegible]ology
Instructional Strategies






3 x 5 CARD
FISHLINE
GLUE
GLUE
FOLD
THUMB TACK
YELLOW
5 TO 7 METERS
BASIC B[illegible]RDFEEDER OR CARDBOARD BOX BIRDFEEDER

Equipment Card *Metric Capers*
MEASURING LENGTH

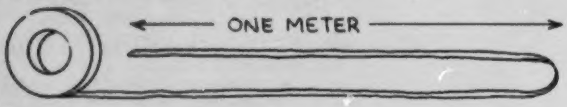
Outdoor Biology Instructional Strategies

MATERIALS:

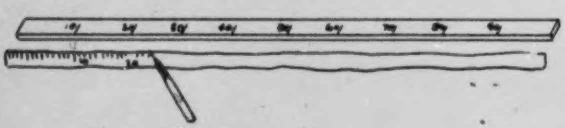
1 marking pen that marks on anything (such as Sanford's "Sharpie")
1 roll of masking tape, or 1 strip of 4 or 6 mil plastic sheeting
1 meter stick

To make your meter tape:

1. Unroll 2 meters of tape and double it over, sticky sides together.

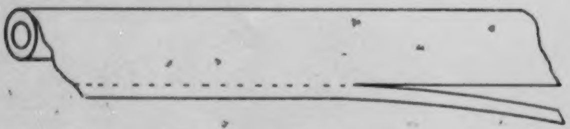


2. Use your meter stick to calibrate your tape with your marking pen.



OR:

1. Cut a 2-cm strip of plastic from a roll of plastic sheeting (4 or 6 mil).



2. Calibrate the sheeting by using the meter stick and marking pen.

Equipment Card *Metric Capers*

MEASURING VOLUME

Outdoor Biology Instructional Strategies

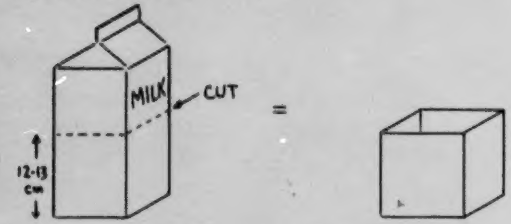
MATERIALS:

1 half-gallon milk carton
1 meter stick or meter tape*
1 pair of scissors
1 250-ml measuring cup*

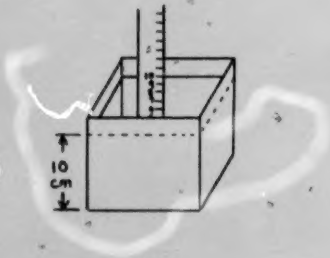
*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

How to make a 1-liter cup (1000 ml):

1. Cut off the top of the milk carton 12 to 13 cm from the bottom.

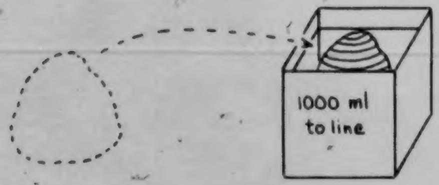


2. Draw a line inside the milk carton 10 cm from the bottom.

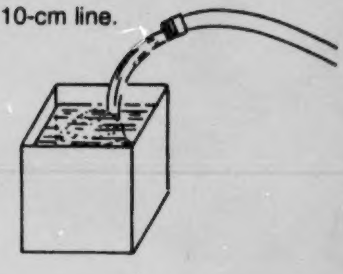


To use your liter cup:

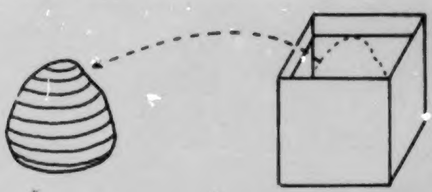
1. Place the object, the volume of which you wish to determine, in the container.



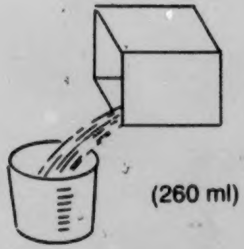
2. Add water to the 10-cm line.



3. Remove the object.

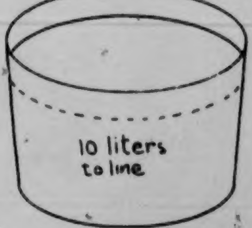


4. Measure the water using your 250-ml measuring cup.



5. Calculate the volume of the object:
1000 - 260 = 740 ml (the volume of the object)

Use your liter cup to make a standard 10-liter bucket. Use this bucket in the same way for measuring the volume of larger objects.



Equipment Card
LITTER SHAKER

Litter Critters

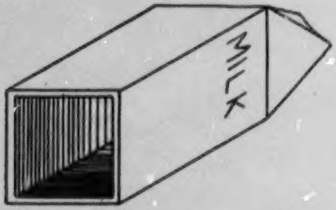
Outdoor Biology
Instructional Strategies

MATERIALS FOR SHAKER:

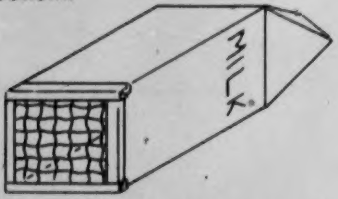
1 half-gallon milk carton
1 9 cm x 9.5 cm piece of hardware cloth screening (½ inch)
1 single-edged razor blade or knife
1 roll of reinforced filament tape or masking tape

TO MAKE YOUR SHAKER:

1. Cut out the bottom of a half gallon milk carton.



2. Tape the square of hardware cloth to the carton bottom.



3. Your shaker is now ready to use.

TO USE YOUR SHAKER:

1. Place litter by handfuls into the carton until it is about half full. Hold the top edges of the carton closed.
2. Shake the carton up and down three or four times over a white-bottomed container. The shaking agitates the animals in the litter and they fall into the container. Because they are agitated, the animals usually scurry about in the pan and are easy to see. Most of the animals will come out in the first or second set of shakes. Check around the screen on the bottom to be sure no animal is stuck to the tape or too big to come through the screen.
3. When you think all the animals are out of the litter in the shaker, dump the litter, put in some new litter, and shake away.

NOTE: It is important to work fast when scooping up litter to put in the shaker because litter critters often move fast.

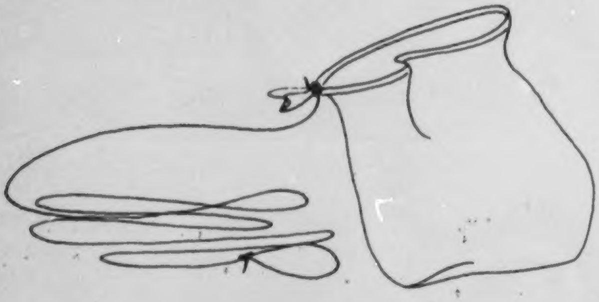
Equipment Card
POPCORN SLINGER

MATERIALS:

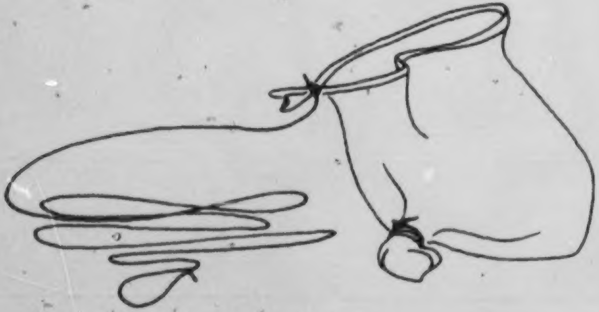
1 cloth bag (burlap, pillow case, feed bag, etc.)
25 meters of heavy twine or light rope marked off in 5-meter intervals

To make a popcorn slinger out of a cloth bag:

1. *Firmly* tie the 25-meter line to one corner of the open end of the bag and tie a loop (large enough to go over a nearby rock or post) at the other end of the rope.



2. Place a weight, such as a rock the size of a tennis ball, in the bottom of the bag and tie it off in one corner to hold it in place.



To use your popcorn slinger:

Practice tossing the empty popcorn slinger a few times before putting in the popcorn. Once you get the feel of it, fill the popcorn slinger with about 20 liters of popped corn and take a strategic position (dock, breakwater, large rock, etc.) from which to toss the corn. Have someone else slip the loop over a rock or post and keep the line tangle-free so it does not hinder the bag's flight. (The loop around the rock keeps the bag from being lost at sea.)

When everything is ready, grab the rope near the bag and start twirling the popcorn slinger over your head. When the bag has gathered momentum, let it fly out over the water. After landing, the weight will pull the bag under the water and the buoyant popcorn will be forced out of the opening of the bag. Before hauling the bag in, let it sink beneath the surface so as not to disturb the spill.

Count the marked intervals as you haul in the bag to determine the spill's starting distance from the shore.

Equipment Card *Seas in Motion*

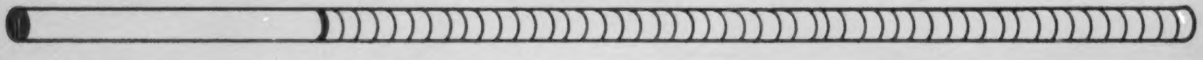
Outdoor Biology Instructional Strategies

TIDE STAKES

MATERIALS:

4 short fence stakes or wooden dowels (about 60 cm long)
2 meter sticks or meter tapes*
2 waterproof marking pens

Mark your 60-cm stake at 1-cm intervals, starting 15-cm from one end.



Measuring Tidal Movement

Vertical Tide Change. At a point inside the active wash zone (where the sand is wet), push the unmarked end of the stake into the sand until the first mark is flush with the surface of the water. When you recover the stake (near the end of the activity), slide your hand down to the water level and pull out the stake. The space between the bottom of your hand and the first mark represents the net gain or loss of water during the time the stake was planted.

Horizontal Tide Change. Sink two stakes into the beach to mark the highest point currently reached by the incoming wave wash. By the end of the period, the tide stakes will either be standing above or below the incoming wave wash. Move one of the stakes to the new highest point, directly inshore or offshore from the remaining stake. The distance between the two stakes marks the horizontal tide change during the period.

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

SAND STAKES

MATERIALS:

4 short fence stakes or wooden dowels (about 60 cm long)
2 meter sticks or meter tapes*
2 waterproof marking pens

Mark your 60-cm stake at 1-cm intervals, starting 15-cm from one end.

Measuring Sand Movement

At a point inside the active wash zone (where the sand is wet), push the unmarked end of the stake into the sand until the first mark is flush with the top of the sand. When you recover the stake (near the end of the activity), slide your hand down to the sand level and pull out the stake. The space between the bottom of your hand and the first mark represents the net gain or loss of sand during the time the stake was planted.

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

Equipment Card *Seas in Motion*

Outdoor Biology Instructional Strategies

WATER BALLOONS

MATERIALS:

12-24 colored, medium-sized balloons
2 turkey basters (giant-dropper type)
1 bucket of sea water

Optional:

dye markers

In the ocean, the ever-popular water balloon can be a neutrally buoyant object (filled with sea water) or a floating object (filled with fresh water). Use the turkey basters to fill the balloons, keeping them the size of tennis balls. To remove air bubbles, gently squeeze the balloons until all the air is removed and then tie them off. You can hand toss the balloons into the water or use a fishing rod. Attaching a dye marker to a balloon will help you trace the balloon's movement.

DYE MARKERS

MATERIALS:

- powdered confectioners dye*
- string

6-10 small cloth bags (teabags, candy or tobacco pouches, or handmade cheesecloth bags)

Confectioners dyes are water soluble and extremely concentrated. Moisten a tablespoonful of dye with water until the dye is gooey; let it dry. Break the resulting cake into pieces the size of a dime and put one piece in each empty tea or cloth bag. Adding a little sand to the bag will make it easier to throw or cast the bags. Dye markers can be tied with string to water balloons and other objects.

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

WATCH OUT!

Confectioners dye is **extremely concentrated.** *Avoid direct contact to prevent stains on hands and clothing!*

Equipment Card *Seas in Motion*

Outdoor Biology Instructional Strategies

MARKED SHELLS

MATERIALS:

- shells

2 waterproof marking pens
2 watches with second hands
2 meter sticks or tapes*

By marking some shells, you can investigate the way the sea moves them. Collect some shells from the beach and mark them on both sides with waterproof marking pens. Toss the shells into the surf either by hand or with your screen-bottomed cup. Clock the amount of time it takes for the marked shells to wash ashore. Measure the horizontal distance the shells travelled from the delivery point to the point where the shells land on the beach.

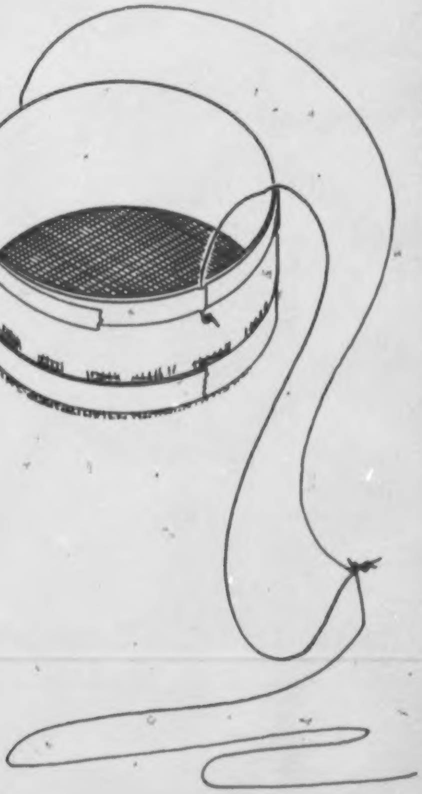
*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

TOSSING CUP (optional)

MATERIALS:

1 small can or plastic cup
1 piece of screen or gauze
- filament or masking tape
- string

You can use a small cup or can to toss objects into the surf by hand or with a fishing rod. Remove the bottom of the cup or can and tape screen or gauze over the bottom. (This cuts down resistance and makes it easier to retrieve the cup.) Masking tape works, but filament tape is better. Cut two pieces of string approximately 25 cm long and tie knots at both ends of each string. Tape the strings to the top of the cup to form a harness. You can now use the cup to toss such objects as marked shells or dye markers into the surf.



Technique Card
DETERMINING HIGH TIDE LEVEL

Beach Zonation

Outdoor Biology
Instructional Strategies

MATERIALS:

1 tide table
1 tide marker flag
1 yard stick
1 line level
1 long stick (up to 8′)
1 ball of string

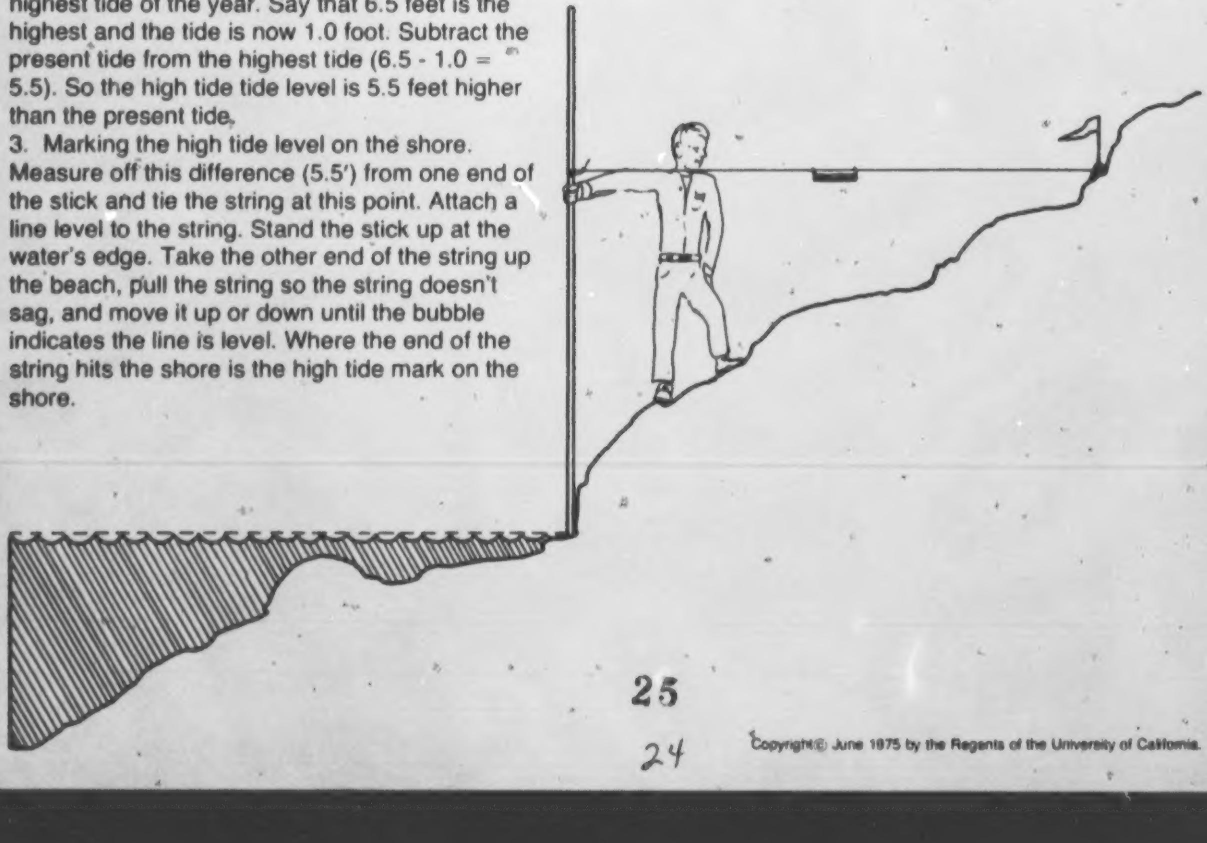
1. To determine the high tide level you will first need to determine the present level of the tide. Check the tide table to see what the tide is at the present time. You will have to estimate if the tide is not at a high or low point at this moment. Example:

The time is now 2:45 p.m.
Tide table says: 9:05 a.m. 5.6′ (high)
3:48 p.m. .5′ (low)

From 9:05 a.m. to 3:48 p.m. (approximately seven hours), the tide will go out (ebb) about 5 feet. So you can estimate that the tide right now is about 1 foot.

2. Now leaf through the tide table and find the highest tide of the year. Say that 6.5 feet is the highest and the tide is now 1.0 foot. Subtract the present tide from the highest tide (6.5 - 1.0 = 5.5). So the high tide tide level is 5.5 feet higher than the present tide.

3. Marking the high tide level on the shore. Measure off this difference (5.5′) from one end of the stick and tie the string at this point. Attach a line level to the string. Stand the stick up at the water's edge. Take the other end of the string up the beach, pull the string so the string doesn't sag, and move it up or down until the bubble indicates the line is level. Where the end of the string hits the shore is the high tide mark on the shore.



Technique Card
USE OF THE TIDE TABLE

Beach Zonation
Flocking to Food
Rock Pioneers
Seas in Motion

With a tide table (available from boating, fishing, and diving shops), you can look up the tidal conditions in your area for any time of any day. Leaf through your table. You may see a range of tides from minus one or two feet to plus six or seven, depending on where you are. Areas may differ, but the range will be consistent month after month. From this information you can determine the vertical height of the intertidal zone. (Subtract the lowest-low from the highest high.) Let us say that in looking in the tide book for the day and time you wish to investigate, you find that the tide is two feet. This means that the upper four to five feet of the intertidal zone is exposed.

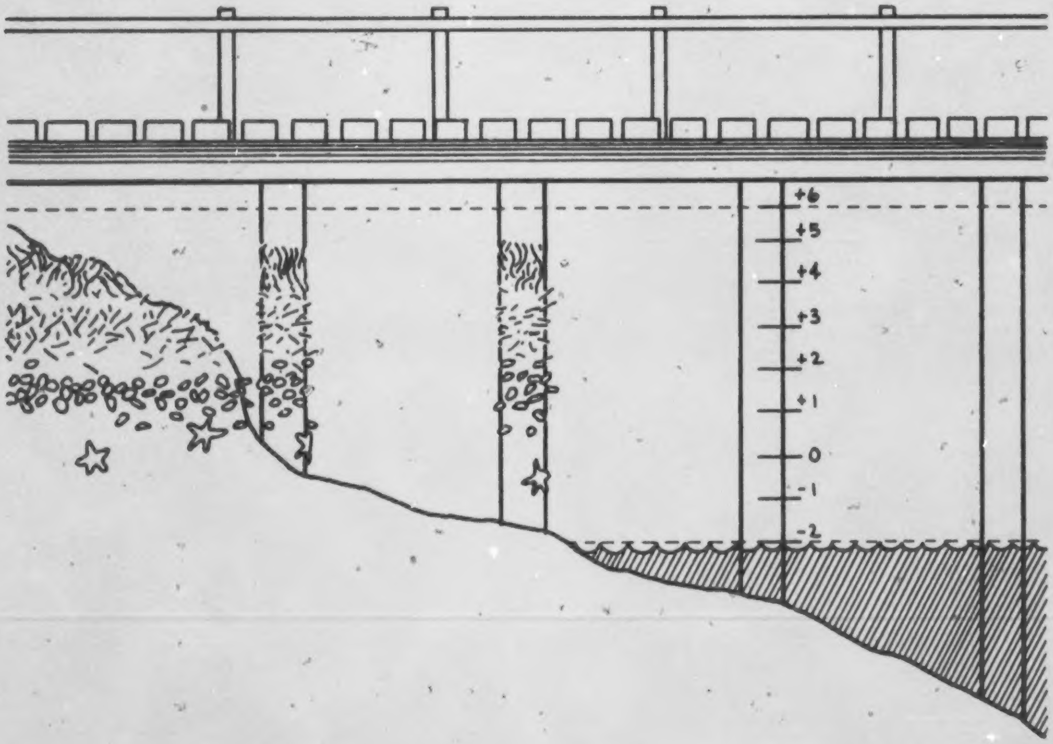
If it is not a high or low tide when you want to study your coastal community, you will have to estimate the height of the tide.

Example: You meet your group at 10:00 a.m.

The tide table reports:

Low Tide:	6:53 a.m.	1.5′
High Tide:	1:10 p.m.	5.1′

10:00 a.m. is about half way between 6:53 a.m. and 1:10 p.m., so your tide will be about half way between 1.5′ and 5.1′ or about 3.2′, and coming in (flood tide). After 1:10 p.m. the tide will be going out (ebb).



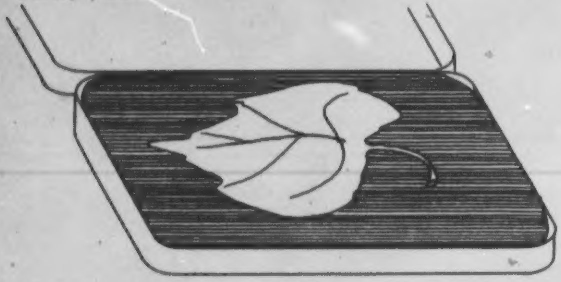
Technique Card
INK PRINTS

MATERIALS FOR ONE PRINT:

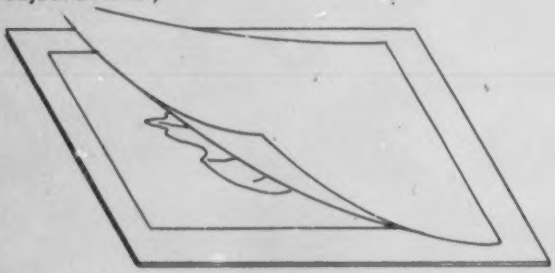
1 ink stamp pad (or ink-covered sponge in container)
2 pieces of paper
1 piece of cardboard backing

PROCEDURE

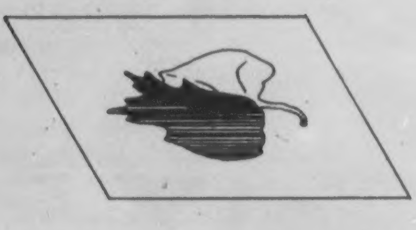
1. Press the object to be printed against the ink stamp pad.



2. Remove and place the object ink-side down on paper against a cardboard backing.
3. Place another piece of paper over the object. (This prevents inky finger prints from obscuring object outline.)



4. Press down firmly over the entire object to transfer ink from the object to the paper.



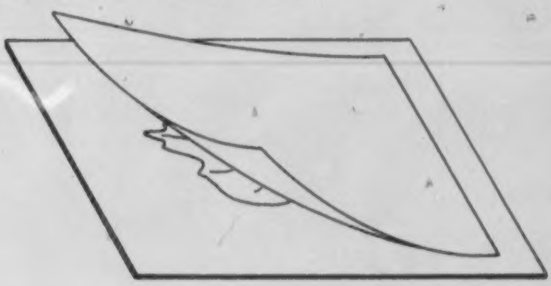
Technique Card
CRAYON RUBBINGS

MATERIALS FOR ONE PRINT:

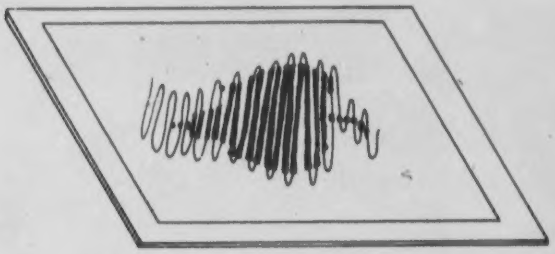
1 piece of cardboard backing
1 piece of paper
1 crayon

PROCEDURE

1. Place the object to be printed on the cardboard or on another hard surface and cover the object with a piece of paper.



2. With a crayon, make a rubbing on the paper over the entire object.



Technique Card
SUN PRINTS

Sun prints are photographs made without camera or darkroom. These prints provide outdoor groups with an interesting method of recording evidence of plants and animals in their natural environment.

MATERIALS

For the group (developing materials):

2 or 3 wide-mouthed, gallon jars of plastic or glass with tops
3-4 cups of gravel or sand
1 grocery bag for each one-gallon container
1 pint of household, non-sudsy ammonia

For each individual or team:

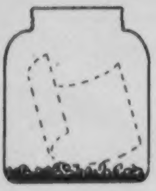
- ozalid paper* in lightproof envelopes (15 cm x 20 cm is a good size)

1 plate of glass or piece of plastic food wrap

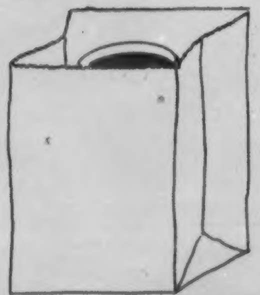
*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

HOW TO MAKE A SUN PRINT

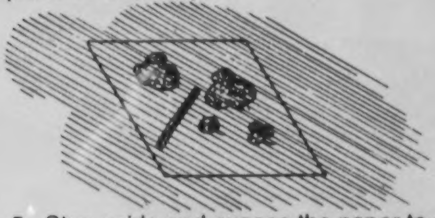
1. Pour enough household ammonia into each one-gallon jar to cover the bottom of the jar.
2. Pour two cups of sand or gravel into the jar and mix it with the ammonia. There should be enough gravel to prevent the ozalid paper from touching the ammonia.



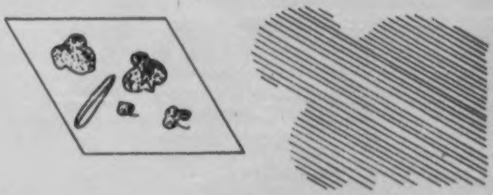
3. Set the jar in a grocery bag to prevent strong light from penetrating the jar.



4. In the shade of your body, remove one sheet of ozalid paper and arrange organisms and objects on the paper. Covering the objects with a clear plate or plastic food wrap will hold the objects flat against the ozalid paper. If objects are wet, place them on top of a glass plate or piece of food wrap.



5. Step aside and expose the paper to direct sunlight for fifteen to thirty seconds.



6. Pick up the paper and quickly put it into the jar. Put the cover on the jar and allow the paper to develop until the image appears (about one minute).
7. If the ozalid prints take too long to develop, or appear too weak, shake up the gravel in the jar to reactivate the fumes. If this doesn't help, add more ammonia.

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OBIS TRIAL EDITION SET 1

The activities listed below appear in the **OBIS Trial Edition Set I** packet, which is still available from the Lawrence Hall of Science. See the "Equipment Order Form" in this folio if you would like to purchase the first packet.

Adaptation – Predator-Prey (All habitats)
Animal Movement in Water (Aquatic habitats)
Animals in a Grassland (Lawns, meadows, and fields)
Attention! (All habitats)
Bean Bugs (Terrestrial habitats)
Great Streamboat Race (Streams)
Habitat Sun Prints (All habitats)
Habitats of the Pond (Ponds and lakes)
How Many Organisms Live Here? (Ponds and lakes)
Invent a Plant (All habitats)
Invent an Animal (All habitats)
Mapping a Study Site (All habitats)
Moisture Makers (Terrestrial habitats)
Natural Recycling in Soil (Terrestrial habitats)
Natural Recycling in Water (Aquatic habitats)
Out of Control (Lawn)
Plant Hunt (Terrestrial habitats)
Plants Around a Building (Building sites)
Seed Dispersal (All habitats)
Sticklers (Terrestrial habitats)
Terrestrial Hi-Lo Hunt (Terrestrial habitats)
Water Holes to Mini-Ponds (All habitats)
What Lives Here? (Aquatic habitats)
Who Goes There? (Terrestrial habitats)

OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES

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Outdoor Biology
Instructional Strategies
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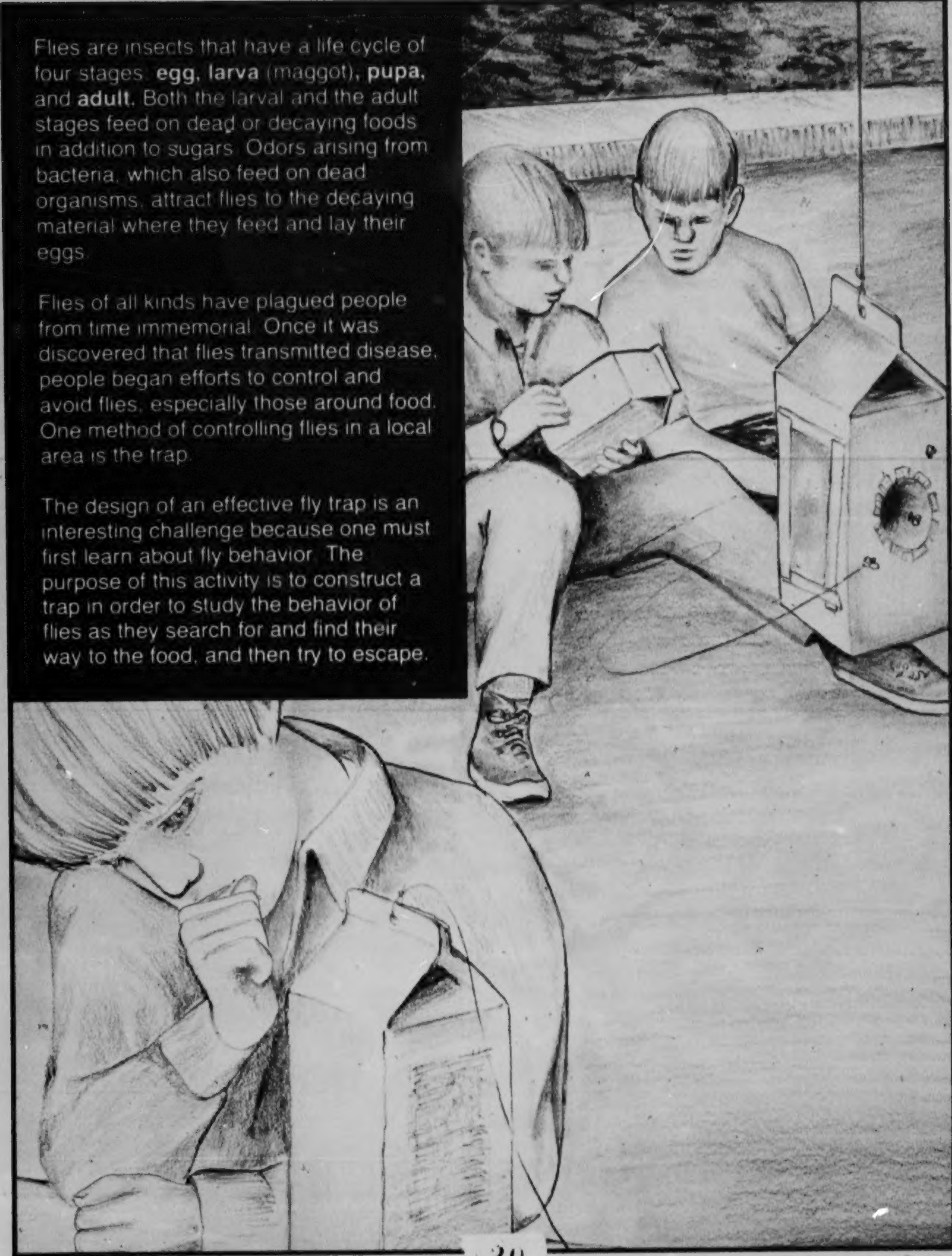
Flies are insects that have a life cycle of four stages: **egg**, **larva** (maggot), **pupa**, and **adult**. Both the larval and the adult stages feed on dead or decaying foods in addition to sugars. Odors arising from bacteria, which also feed on dead organisms, attract flies to the decaying material where they feed and lay their eggs.

Flies of all kinds have plagued people from time immemorial. Once it was discovered that flies transmitted disease, people began efforts to control and avoid flies, especially those around food. One method of controlling flies in a local area is the trap.

The design of an effective fly trap is an interesting challenge because one must first learn about fly behavior. The purpose of this activity is to construct a trap in order to study the behavior of flies as they search for and find their way to the food, and then try to escape.



MAKE A DEVICE THAT ATTRACTS AND TRAPS FLIES.

In this activity, each participant constructs a fly trap designed to attract and catch flies. The youngsters observe the flies' behavior and responses to the traps, bait, and surrounding environment. The behavior of the flies is used as a guide to the modification of the traps. The kids then retest the modified traps to see if they attract and catch more flies than the original traps.

MATERIALS

For each youngster:

- fly bait: 1 to 3 pieces of fish, or other fly-attracting food
- milk carton or paper box (you may want a few extra cartons)

For the group:

- window screen, nylon is best (enough pieces for each kid to to cover a milk-carton half)

1 junk box containing: scissors, straws, paring knives, paper plates, plastic wrap, aluminum foil, tape, transparent plastic bags, popsicle sticks, rubber cement, stapler, string, cheesecloth (small mesh)

PREPARATION

Obtain some fish parts such as heads, intestines, or other parts for fly-trap bait. You can freeze the fish parts for convenience, but they must be warm to attract flies. A calm, warm day in an area with flies provides the best activity situation. If you do not see any flies at a site you like, attract some by baiting the area before the participants arrive. Before the activity begins, either bury this early bait or make use of it in the activity.

ACTION

1. Expose the bait to the air.
2. Tell the kids you brought the smelly fish to use as bait in the fly traps they will be constructing. The bait may already be drawing flies by this time and the youngsters will need no further encouragement to make a trap.
3. Challenge the kids to design and build a fly trap using the materials you have provided. Tell the kids that flies usually fly upwards and toward light when escaping. Some children "think with their hands" and will want to start on their traps immediately. Others may want to ponder the problem before starting construction. Traps can be free hanging or fixed on a surface, any shape or combination of materials, etc.

TEST THE TRAPS

After constructing the traps, the kids test them to see if they really attract and trap flies. Let the experts show the others how to improve their traps. You can also test the traps to see which is best. Testing two or more traps in the same area, at the same time, and with the same bait, will provide a fair comparison of the traps. This fair comparison is called a **controlled experiment** because all but one of the factors (such as location, shade, wind, time of day, etc.) which can vary, are controlled. If you think your group might benefit from your explanation of a controlled experiment, use the fair comparison approach to explain it.

OUTWIT THE FLIES

Encourage the youngsters to watch the behavior of the flies as they approach, fly around, land, enter, and try to escape the trap. Observations of the flies' behavior will provide the information needed to improve the traps. Some traps will not allow the smell to come out, while others will not hold the flies in. In other traps, the flies will not be able to find their way to the bait. These are examples of problems encountered in our trial experiments. Encourage modification of the existing traps rather than construction of new traps for a small improvement such as making a smaller entrance hole.

You may wish to run a timed test for all the traps at the same time in order to determine which traps work best. Then try to figure out why certain traps are better than others. Traps that keep the bait moist, have small entry holes low on the trap, and have at least one window near the top seem to work best.

WHAT DO YOU THINK?

☐ How do flies approach the trap?
☐ Why do you think the flies don't escape?
☐ What happens when you rattle the trap?
☐ What other organisms are attracted and caught by your trap?
☐ What recommendations do you have for a home or camp with a fly problem?
☐ What feeding role do you see flies playing in the ecosystem?

FOLLOW THROUGH

☐ Try different or wetter baits.
☐ Try suspending the trap from a long string to see if flies will land on a moving object.
☐ Paint your trap different colors to see if color makes a difference in fly catching.
☐ Make more traps and sell them.
☐ Does your trap catch more flies at night or during the daytime?

Disposing of captured flies. Flies may be sold to pet shops as frog and turtle food, submerged in water and released as fish food, left in the traps to become bait for other flies, let go, etc.

The last thing to do: Have the kids wash up!

WHAT TO DO NEXT

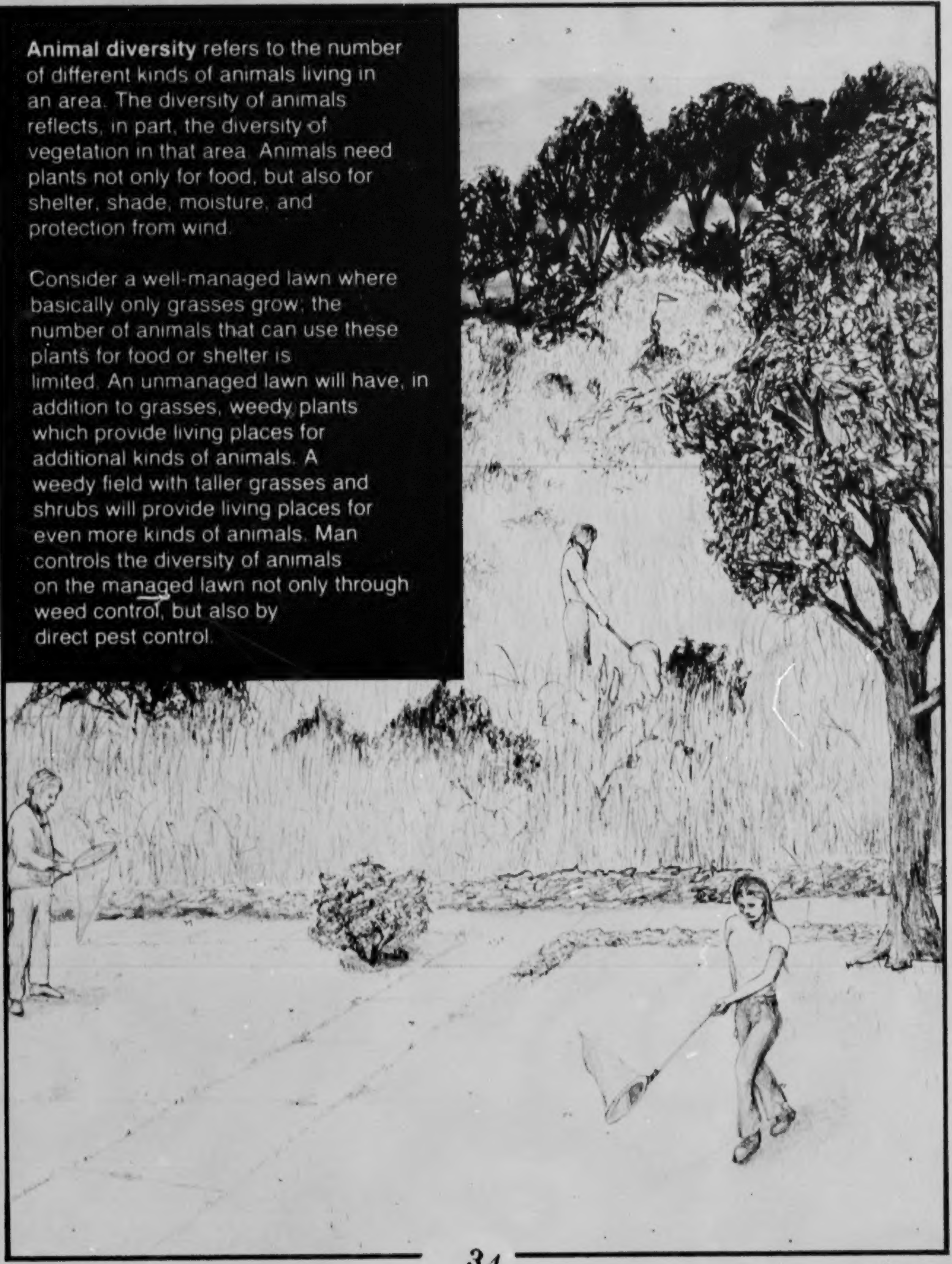
	Set
Too Many Mosquitoes	*II*
Crawdad Grab	*II*
Old White Sheet Trick	*II*

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

Animal diversity refers to the number of different kinds of animals living in an area. The diversity of animals reflects, in part, the diversity of vegetation in that area. Animals need plants not only for food, but also for shelter, shade, moisture, and protection from wind.

Consider a well-managed lawn where basically only grasses grow; the number of animals that can use these plants for food or shelter is limited. An unmanaged lawn will have, in addition to grasses, weedy plants which provide living places for additional kinds of animals. A weedy field with taller grasses and shrubs will provide living places for even more kinds of animals. Man controls the diversity of animals on the managed lawn not only through weed control, but also by direct pest control.



FIND AS MANY DIFFERENT KINDS OF ANIMALS AS YOU CAN IN A MANAGED LAWN SITE AND AN UNMANAGED WEEDY AREA.

The diversity of plants growing in a site affects the number of different kinds of animals living there. An unmanaged area with weedy plants and grasses is likely to support a greater diversity of animals than a managed grassy area. In this activity, your participants investigate these two types of sites.

MATERIALS

For each individual (or team of two):

1 sweepnet
2 plastic bags
2 rubber bands

Optional:

1 *Lawn Guide* or other identification guide
1 hand lens or bug box

For the group:

25-30 small, transparent vials or jars with lids (plastic is best)

For FOLLOW THROUGH:

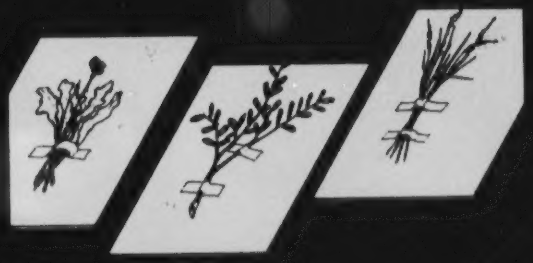
You will need one plant card for each team of two, plus a few extras. Materials include 20 x 30 cm pieces of cardboard, samples of various plants, and masking tape.

See the Sweepnet Equipment Card in the *OBIS Toolbox* folio. If the participants make their own, allow a separate session for construction.

Available from the Lawrence Hall of Science. See the Equipment Order Form in the *OBIS Toolbox* folio.

PREPARATION

Choose two nearby areas with different types of vegetation, such as a managed area (lawn or cultivated field) and an unmanaged area (weedy lot or edge row). A sunny day provides more exciting results because more animals are active. Take a sweepnet in hand and try sampling the sites yourself before doing the activity with your group. If you plan to do the FOLLOW THROUGH, prepare the plant cards ahead of time. Pick samples of various abundant plants in the weedy area (one for each team of two) and tape each plant to a piece of cardboard.



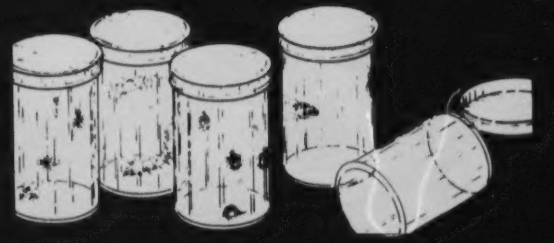
ACTION

1. Explain to your participants that they will be comparing the number of different kinds of animals, particularly insects, found in two different areas: a managed area, and an unmanaged, weedy area. In order to have an accurate comparison, the kids must sweep the managed area about the same number of times as they sweep the weedy area. For the investigation, each team will need a "sharp eye," a sweepnet and a plastic observation bag.

2. Demonstrate the use of the sweepnet and the method of transferring the catch into the bag. (See "Sweepnet" equipment card.)

3. Divide the group into teams of two and challenge the teams to find and collect as many different kinds of animals as they can in the managed area. Pass out the sweepnets and bags and let the investigation begin!

4. After ten to fifteen minutes, call the participants together to share the catch. Make *Lawn Guides* and lenses available for use if you have them. As a group, put one of each kind of animal found into a clear vial and line up the containers at a central shady location. You might want to serve as a coordinator. Make sure each container holds only one kind of animal. (Duplicate animals can be released or placed in the same container.) The end result is a row of



containers—each holding a different kind of animal. How many different kinds of animals were found in the managed area?

5. Any animals remaining in the plastic bags should be released.

6. Now send the participants with their sweepnets and bags to the second site to find as many different kinds of animals as they can. Remind them to sweep about as much as they did on the lawn.

7. When the time is up, call the teams together and organize the catch again using the clear vials. This time you might assign a youngster to be the lineup coordinator. How many different kinds of animals were found in the unmanaged area? How does this number compare to the managed area? Don't forget to release all animals at the end of the activity.

THE CLEAN SWEEP

☐ What are some of the differences between numbers and kinds of animals found in the managed site and those found in the unmanaged site? How might you account for these differences?

☐ Introduce the term **animal diversity**: the number of different kinds of animals found in an area. How does man influence the diversity of animals?

☐ What might be some of the advantages for an insect or other small animal in having a diversity of plants and animals in an area? Consider food sources and living places.

☐ As a human, which of the two areas do you prefer and why?

☐ If an area is not a suitable living place for a certain animal, that animal simply will not be found there. Do you think this applies to humans as well as other animals?

FOLLOW THROUGH

Finding the most popular plant. Bring out the plant cards and explain that each team will select one card and go into the weedy site and bring back those animals associated with the plant on the card. (No sweepnets allowed this time! The participants use only plastic bags and vials or bug boxes.) The plant associated with the greatest diversity of animals will be the most popular plant. Which plant was the most popular? Did you notice certain animals associated with only one kind of vegetation?

WHAT TO DO NEXT

	Set
Old White Sheet Trick	II
Plant Patterns	II
Plant Hunt	I
What Lives Here?	I

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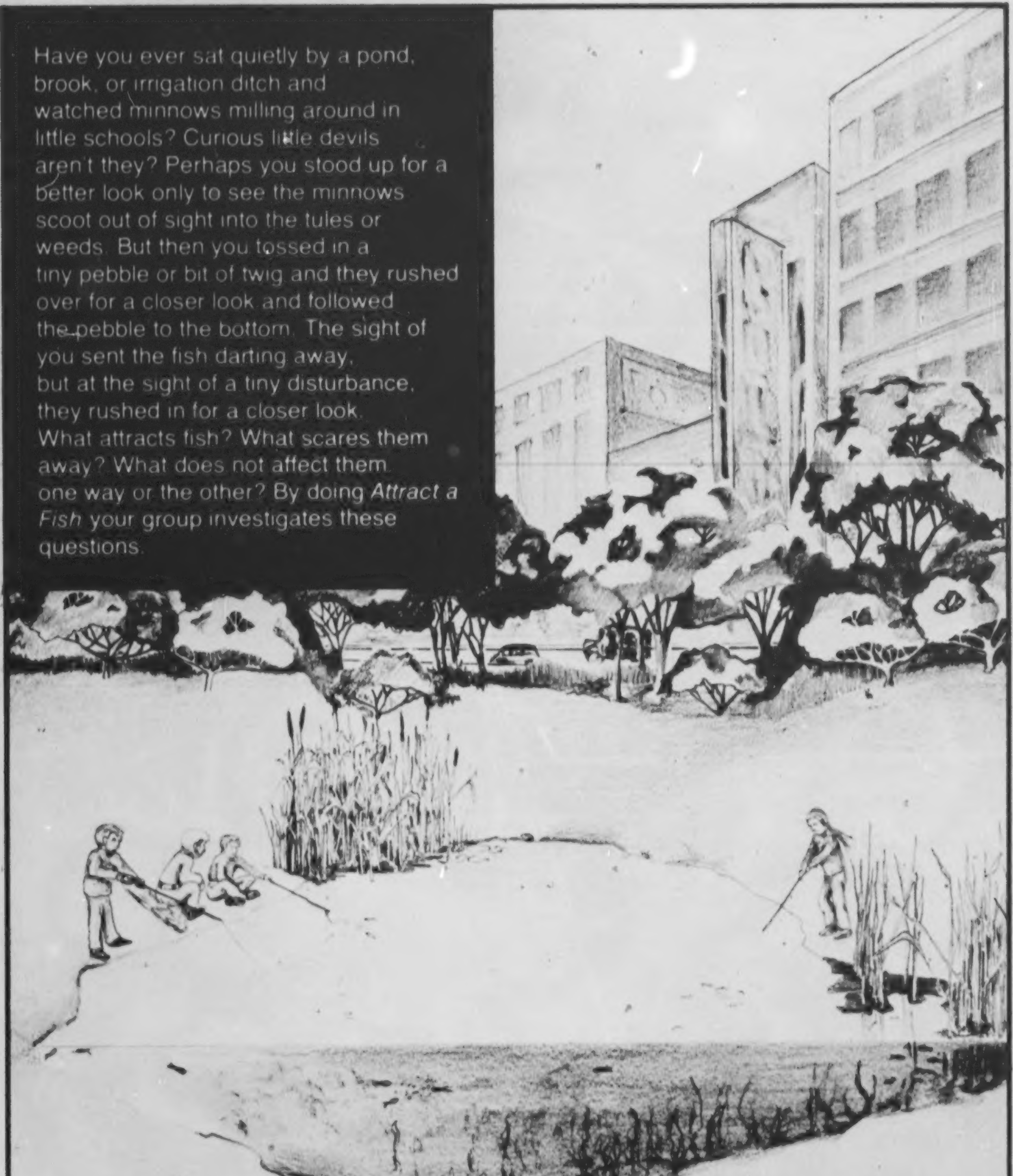
Have you ever sat quietly by a pond, brook, or irrigation ditch and watched minnows milling around in little schools? Curious little devils aren't they? Perhaps you stood up for a better look only to see the minnows scoot out of sight into the tules or weeds. But then you tossed in a tiny pebble or bit of twig and they rushed over for a closer look and followed the pebble to the bottom. The sight of you sent the fish darting away, but at the sight of a tiny disturbance, they rushed in for a closer look. What attracts fish? What scares them away? What does not affect them one way or the other? By doing *Attract a Fish* your group investigates these questions.



USING SIMPLE EQUIPMENT AND YOUR IMAGINATION, DISCOVER WHAT ATTRACTS MINNOWS.

MATERIALS

For each kid:

1 thin stick (1 meter or more in length)
1 meter-length piece of thin wire (see PREPARATION section)

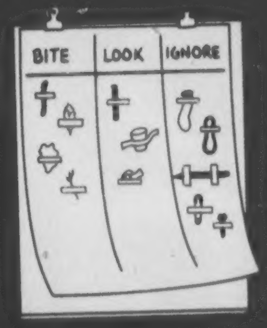
For the group:

1 data board
1 marking pen
1 junk box (small bits of string, cotton paper, rubber bands, aluminum foil, colored paper, wire, cork, meat, vegetables, shiny stuff, heavy stuff, floating stuff, colorful stuff, etc.)
2 rolls of clear tape

PREPARATION

Site. Select a pond, brook, or irrigation ditch that contains minnows.

Fishing Pole. Each kid can prepare his own fishing pole from a piece of stick, cane, or twig by attaching a short length of thin wire to one end. You can obtain suitable wire by taking apart a one-meter length of multi-strand household electric cord. Rip the wire bundles out of the rubber insulation and carefully pull the tiny strands apart. For a substitute, you can purchase #32 wire from a hardware store. Wire is easy for kids to use; they can quickly twist lures on and off.



Score Sheet. To keep track of what does and does not attract fish, prepare a score sheet for your data board.

Buddy System. Review the SAFETY section in the *Leader's Survival Kit* folio for information on buddy teams.

ATTRACT A FISH

ACTION

1. Upon arrival at your "fishin' hole," define the limits of the study area and divide your group into buddy teams. Introduce the activity by pointing out the minnows and challenging the youngsters to attract the minnows to the surface.

2. Hold up a "fishing pole" and suggest to the group that such a rig may be useful for experimenting with possible attractors. Bring out the materials and let the youngsters make their poles. Circulate among the children and offer assistance if needed.

3. While the youngsters build, hold up the data board with score sheet (See PREPARATION.) Tell the kids that each time they try a lure (attractor), they should tape the lure in the appropriate reaction column on the score sheet. Encourage them to try several lures.

Let the fishing begin!

NOTE: Kids will tend to use large lures. You may have to hint at the use of tiny lures (less than ½ cm in any dimension) by encouraging unsuccessful anglers to compare their lures to those made by successful anglers.

4. **Making discoveries.** While the youngsters experiment, circulate and ask questions. If they used the same size lure, but red instead of black, would fish respond? Does a lure with odor work better than one without? Will fish come to a lure when it is jiggled? Encourage a wide variety of experimental efforts.

5. **Fishing for answers.** After the youngsters have experimented with a variety of lures, call everyone over to the score sheet to view the results. You should have a number of lures in each of the three columns. Try some of the following questions to focus attention on the properties of lures that make them either successful or unsuccessful.

a. Which lures were the best attractors?
b. Which lures did not attract any fish?
c. What does the size of the lure have to do with attaction?
d. Does the color make any difference?
e. Does motion of the lure have any effect? What effect?
f. Do surface lures work better than underwater lures? How do lures on the bottom work?
g. Do fish respond to the taste of your lure?

6. **The Super Lure** (optional). On a clear space on your score sheet write "Properties of Good Lure" and have the kids name the properties as you write them down. These properties should combine to make a "super lure."

7. Have the kids construct the "super lure" from the junk box and return to the fish pond to attract fish. Do the youngsters have more success with the super lure than they did with their first lures?

A NEW ANGLE

Explain to the kids that they have systematically discovered a lure that stimulates fish to bite. Use your super lure to investigate the following questions. You may wish to make action cards from these ideas and any others that you or the kids come up with.

☐ Do fish get tired of your super lure and ignore it? How long does it take?

☐ How far away can a fish be and still sense your super lure?

☐ Can you bring a super lure up behind a fish without it detecting the lure? Does the fish eventually see the lure or might other senses be involved first?

☐ Will two fish fight over your super lure?

☐ What happens when you skim your super lure rapidly across the surface of the water?

FOLLOW THROUGH

☐ Now you know what stimulates fish to bite. Go to the fish pond and locate some living organisms that might be food sources for the fish. If possible, catch some fish and keep them for a while in an aquarium. Try feeding them your potential live food.

☐ Can sound alone attract fish? Design an experiment to find out.

☐ What scares fish away?

☐ Can you discover a predator that preys on the minnows in your pond?

☐ What changes occur in a pond when fish are present? Set up a pair of identical mini-ponds, one with minnows and one without. (See *Water Holes to Mini-Ponds*, Set I.) Be sure to include some pond bottom, plants, and as many different kinds of animals as possible. Observe changes over a length of time.

WHAT TO DO NEXT

	Set
Old White Sheet Trick	*II*
Water Breathers	*II*
Animal Movement in Water	*I*
Water Holes to Mini-Ponds	*I*

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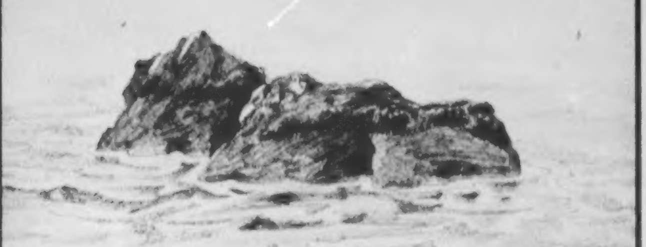
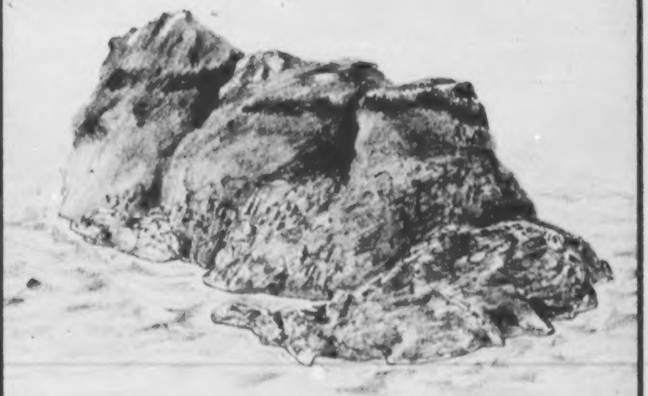
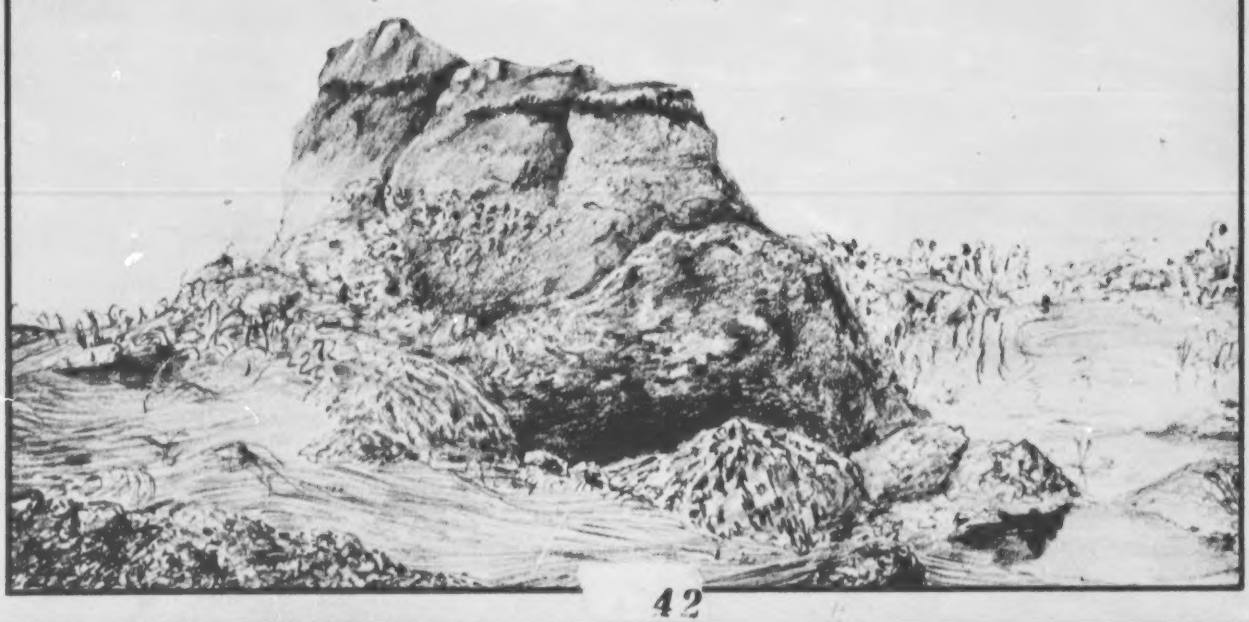
NOTE TO USER! This activity is best conducted: 1) at a breakwater, rocky shoreline, or rocky fill area; and 2) after a general introduction to the site familiarizing the kids with the organisms. The activity is conducted in feet rather than meters because tide tables currently give measurements in feet.



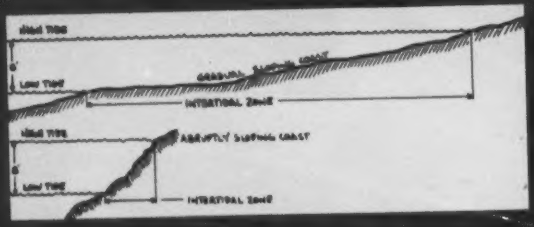
THE INTERTIDAL ZONE

The seas of the world do not lie in their basins like water in a bathtub, but are drawn back and forth by the gravitational pull of the sun and moon. The result is tides. Twice a day (in most parts of the world) the tide comes in and goes back out. This part of the coast alternately covered by water and exposed to air is the **intertidal zone.** Along the west coast of the United States the vertical depth of the intertidal zone is about eight feet. Where the slope of the coast is very gradual, an eight-foot vertical rise of





water may result in an intertidal zone extending several hundred feet up the beach. Contrast this gradual slope with a rocky headland, seawall, or breakwater where the slope of the coast is abrupt. Here an eight-foot vertical rise means the water is eight feet deeper. In a short horizontal space the intertidal zone is more compressed.



USE THE RANGE OF AN ORGANISM LIVING AT YOUR STUDY SHORE TO DEFINE AN "UPPER ZONE."

When you go to the seashore at a very low tide, you can walk among the plants and animals of the intertidal zone and often observe bands or zones of natural distribution. Some of the organisms are adapted for withstanding longer periods of exposure to air than others and are found higher in the intertidal zone. Those adapted for short exposures to air are found lower in the intertidal zone.

In this activity the youngsters divide the intertidal zone into two or more zones. You can make this investigation any time the tide is at least half way out. The participants look for the organism living *highest* in the intertidal zone, discover the organism's range (the vertical length of the area in which that organism lives), and arbitrarily designate that range as the "upper zone."

MATERIALS

For each team:

1 collection container (milk-carton half)
2 small flags
2 lumps of clay

For the group:

2 yard sticks
1 tide table
1 watch
3 larger flags (2 boundary markers and 1 high tide flag)
2 sticks, 6 to 7 feet long
2 balls of string
2 line levels

Available from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

PREPARATION

You can conduct this activity when at least half the intertidal zone is exposed. Check your tide table for the best day and time to work with your group. (See the "Use of the Tide Table" technique card in the *OBIS Toolbox* folio.) A minus tide means the entire intertidal zone is exposed, but a plus tide of five feet or more means very little of this zone is available for study.

ACTION

1. Use your boundary marker flags to mark off your study site: fifty yards of shoreline will suffice.

2. Define the intertidal zone for the group. Then divide your group into buddy teams. (See the SAFETY section in the *Leader's Survival Kit* folio.) Distribute one small flag, one lump of clay (for the flagbase), and one collection container to each team. Release the teams to find and flag the organism (plant or animal) living highest on the shore (rocks, breakwater).

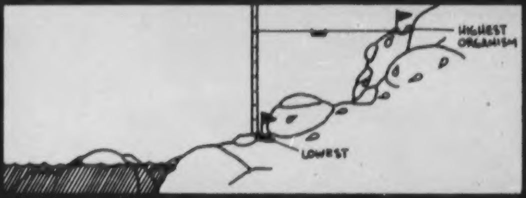
3. Viewing the results of the hunt. Did everyone flag the same organism? If so, you have identified your study organism. If two or more organisms have been flagged, determine as a group which organism can be found living highest in the site.

4. How low do they go? Send each team back to the site with a second flag. The teams should look for and flag the *lowest* place they can find the study organism living.

5. After the teams have flagged the "low spots," demonstrate the use of the line-level rig. (See the "Determining High Tide Level" technique card in the *OBIS Toolbox* folio.) Combine the teams to make two groups, and give each team a line-level rig.

6. **High Tide.** Give one group the "Determining High Tide Level" card, a tide table, and a large flag, and turn the group loose to find the high tide mark using the line-level rig.

7. **Range.** Send the second group out to relocate the highest and lowest places where the study organism was found. How many vertical feet are there between the highest and lowest flags? Using the line-level rig, someone can hold the stick upright next to the lowest organism and someone else take the other end of the string up to the highest organism. The string should be pulled tight and slid up and down the stick until the string is level. By measuring the vertical distance from the base of the stick to the string, the group will have the range of the study organism. This range is your working definition for the upper zone.



THINKING ABOUT ZONATION

Did your study organism's range extend *above* the high tide mark? If so, how do you explain this?

Adaptations are features of an organism that allow it to survive in its environment. Which adaptations does your study organism have that allow it to survive in the upper zone?

What other organisms did you notice in the upper zone? Why do you think they were in the upper zone instead of in a lower zone?

FOLLOW THROUGH

1. During a lower tide, locate an organism whose range defines a lower zone. Do the two zones overlap?
2. During a low tide, stand and look at the intertidal zone. Can you see bands of similar organisms (brown seaweed, mussels, green seaweed, starfish)?

WHAT TO DO NEXT

	Set
Rock Pioneers	*II*
OBIS Oil Spill	*II*
Water Breathers	*II*
Habitats of the Pond	*I*

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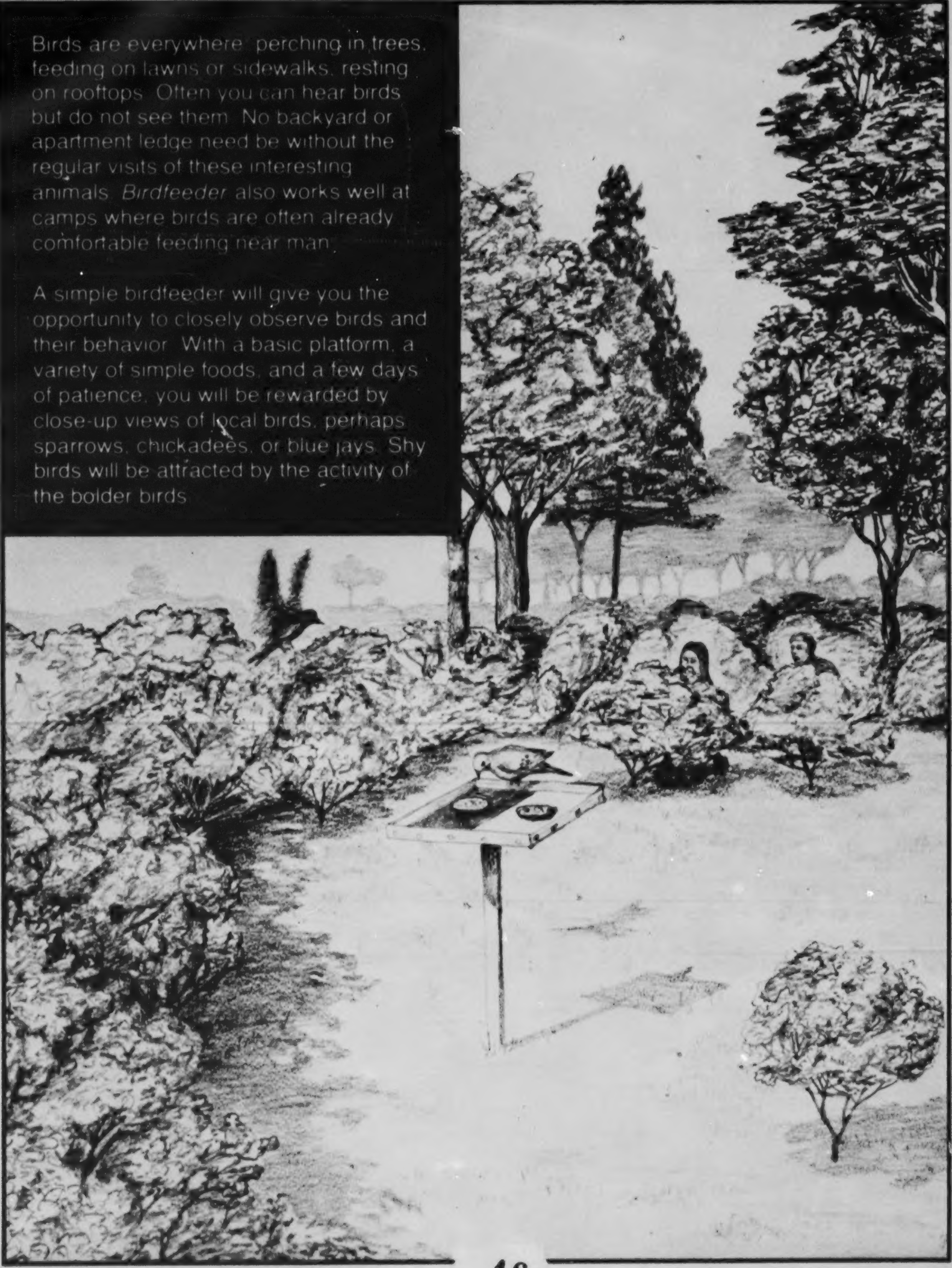
Birds are everywhere: perching in trees, feeding on lawns or sidewalks, resting on rooftops. Often you can hear birds but do not see them. No backyard or apartment ledge need be without the regular visits of these interesting animals. *Birdfeeder* also works well at camps where birds are often already comfortable feeding near man.

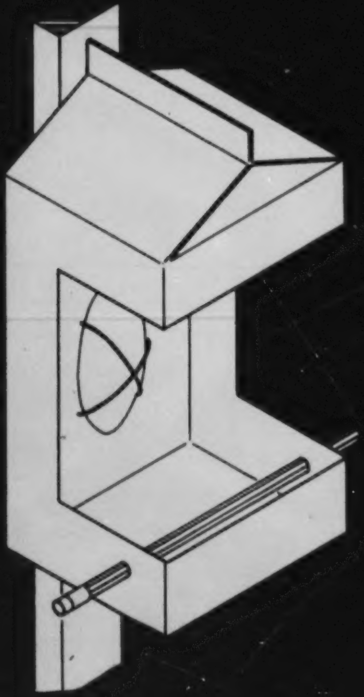
A simple birdfeeder will give you the opportunity to closely observe birds and their behavior. With a basic platform, a variety of simple foods, and a few days of patience, you will be rewarded by close-up views of local birds, perhaps sparrows, chickadees, or blue jays. Shy birds will be attracted by the activity of the bolder birds.



Birdfeeders can be done individually or as a group. It can be a construction activity in which kids build the feeders and take them home to practice observing local birds. At a camp, children can construct feeders at the opening of camp and within four days find birds using the feeders. Time can be set aside for children to observe, experiment, and even photograph feeding birds.

Caution! Birds can become dependent on feeders as a source of food especially in winter when natural foods are scarce. Therefore, do not discontinue a feeding program when natural foods are scarce.

ATTRACT BIRDS TO YOUR FEEDER AND OBSERVE THEIR BEHAVIOR.



MATERIALS

For each feeder:

1 40cm × 30cm piece of wood
1 stake (1.5 meters long) on which to mount your platform
2 jar lids about 7 cm in diameter
- scrap cardboard for edging your feeder

1 set of Action Cards
- Bird foods: small seeds (parakeet or canary food), large seeds (pigeon food, chick mash), unsalted sunflower seeds, popped popcorn, raisins, suet (beef fat), peanut butter

For the group:

- thumbtacks
- fish line (light-test monofilament)
- colored construction paper
- clay
- crayons and felt pens
- scissors
- plastic sandwich bags

1 hammer and nails, small tacks, and large nails

PREPARATION

Find the following equipment cards in the *OBIS Toolbox* folio:

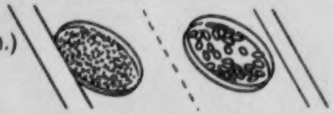
Basic Birdfeeder
Eyespot
Model

BIRDFEEDER
Action Card #1

Outdoor Biology Instructional Strategies

Food Choice. Discover the preferred foods of birds in your area.

1. Use a hammer and nail to punch a hole through two jar lids and tack a lid to each end of your feeder.
2. Offer the birds a choice by filling each lid with a different food. Try one of the following combinations or create your own.
   - a. small seeds and large seeds
   - b. seeds and suet (Tie suet down.)
   - c. raisins and suet
   - d. popcorn and seeds
3. Check your feeder daily to see which foods the birds choose.
4. Over a period of several days, change the available food choices to discover which food the birds prefer.



BIRDFEEDER
Action Card #2

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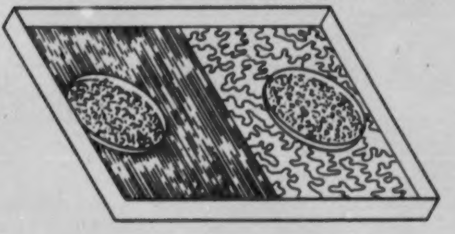
Background. Discover the color, texture, and/or pattern of background that your birds prefer to eat from.

Divide your feeder in half. Use a different color, texture, or pattern in each half of the feeder. Fill each jar lid with the *same food*. Experiment for several days to see if the background design has any effect on the birds' feeding behavior.

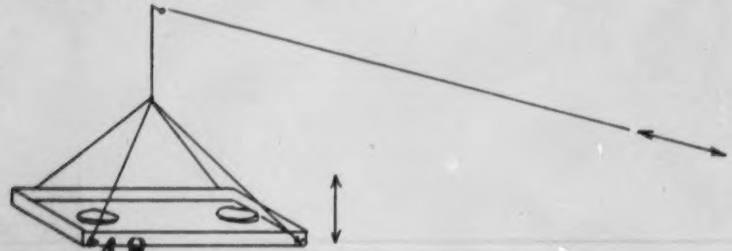


BIRDFEEDER
Action Card #3

Outdoor Biology Instructional Strategies

Movement. Will birds eat from a hanging or moving feeder?

1. Insert a nail into each corner of your feeder. Attach fishline to the nails and hang your feeder from a tree limb or from house eaves.
2. While the birds are feeding, move the feeder up and down and see what the birds do.

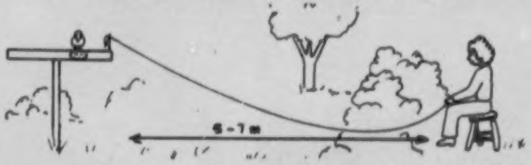


BIRDFEEDER
Action Card #4

Outdoor Biology Instructional Strategies

Eyespots. How do birds respond to cat-eye and owl-eye spots on moths and butterflies?

1. Using the "Eyespot" equipment card, construct a moth model. Thumbtack the model to your feeder. "Flash" the eyespot by pulling the fish line when a bird lands on the feeder. Vary the size and color of the model.
2. What do the birds do when you flash the eyespot? Why do you think moths and butterflies are colored this way?



BIRDFEEDER
Action Card #5

Outdoor Biology
Instructional Strategies

Models. How do birds respond to animal models? Construct models that will attract or frighten birds.

1. Use the patterns on the "Bird Model" equipment card and construction paper to make bird models. Paint or color them to resemble birds seen at your feeder. Thumbtack the models to your feeder and observe the reactions of the birds.
2. Try a clay snake model.

BIRDFEEDER
Action Card

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BIRDFEEDER
Action Card

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BIRDFEEDER
Action Card

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ACTION

1. Briefly discuss past experiences the youngsters have had with birds. Tell the kids they will be constructing a birdfeeder and other materials to take home. Some children may want to work as a team, sharing a single feeder at one of the team member's homes; others may wish to work alone.

2. See the "Birdfeeder" equipment card in the *OBIS Toolbox* folio for instructions on building the basic birdfeeder. Have the kids construct their feeders. Offer assistance where needed.

3. Have each kid select three or more of the duplicated action cards. (Tell the group that several days may be required to observe the events for one action card.) Let the kids select the foods for their feeders, and assemble the additional materials required for each action. Pass out sandwich bags and paper bags for the kids to use to carry their materials home.

4. **Where to place the birdfeeders.** The feeders may be nailed to fence tops, window sills, or a stake firmly pounded into the ground. Emphasize that a good location for the feeder will insure that birds find and use it. The feeder should be visible to the birds and to the observer. There should be shrubs or trees nearby to provide access to the feeders and a means of escape from predators. Ask individuals to describe where they plan to put their bird feeders. Remind the kids that it may take the birds several days to discover the feeders.

WHAT DO YOU THINK?

If your birdfeeders are established at a camp, discuss daily any observations the children make. Such interchange often leads to interesting new modifications of the birdfeeder or experiment.

If *Birdfeeder* is conducted as a construction activity with participants taking their feeders home, allow one to two weeks before gathering your group to discuss their birdfeeder experiments.

QUESTIONS to consider:

What foods did the birds eat?

Did different kinds of birds eat different foods?

How many different kinds of birds were seen at a feeder at the same time?

Do birds appear at the feeder at the same time each day?

Did you see birds who did not come to your feeder? How can you change your feeder or food to attract these birds?

Did you observe birds eating natural foods similar to food you offered them?

WHAT TO DO NEXT

	Set
Flocking to Food	*II*
Plant Patterns	*II*
Adaptation – Predator-Prey	*I*
Who Goes There?	*I*

Outdoor Biology
Instructional Strategies
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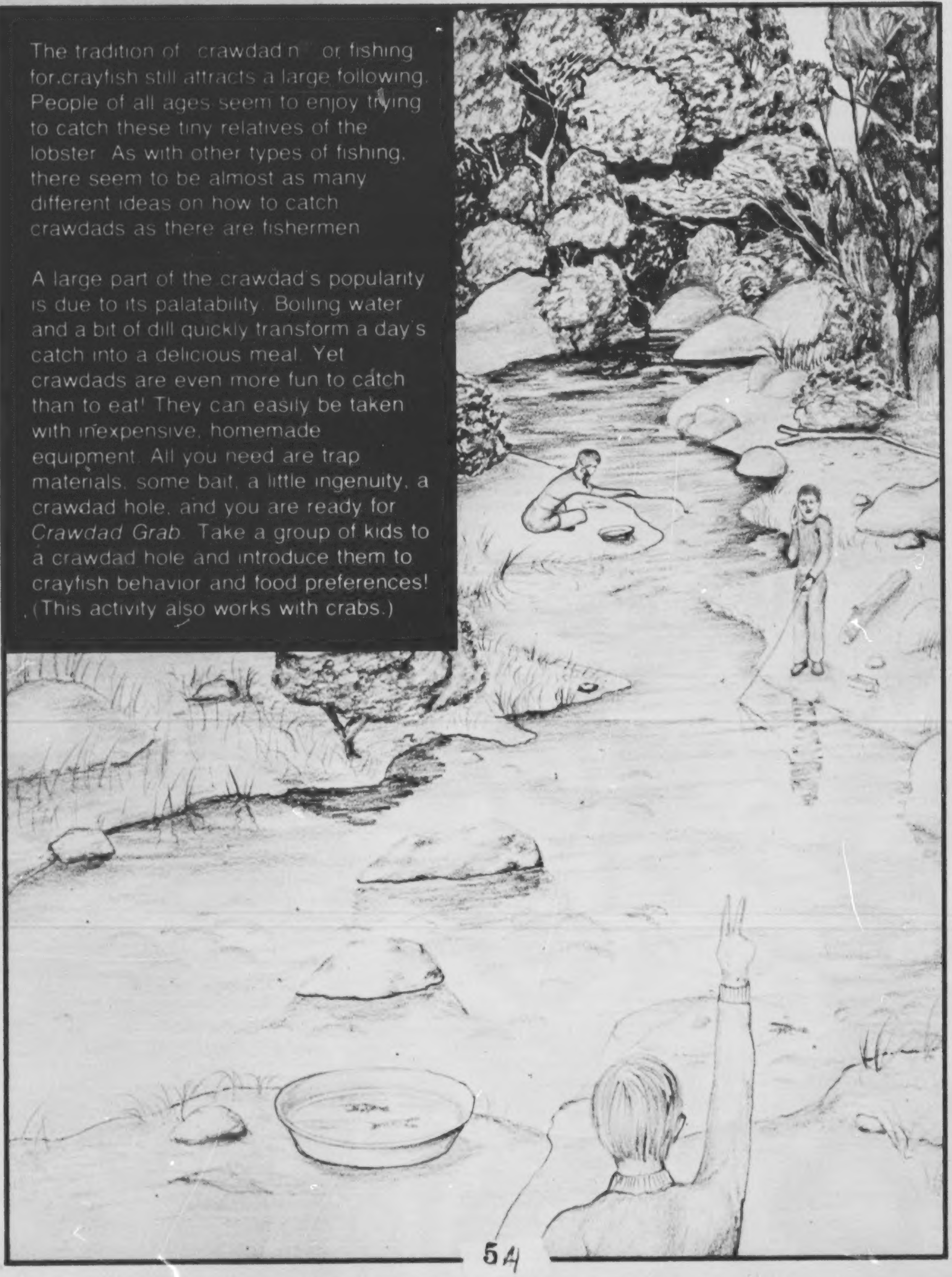
The tradition of crawdad'n' or fishing for crayfish still attracts a large following. People of all ages seem to enjoy trying to catch these tiny relatives of the lobster. As with other types of fishing, there seem to be almost as many different ideas on how to catch crawdads as there are fishermen.

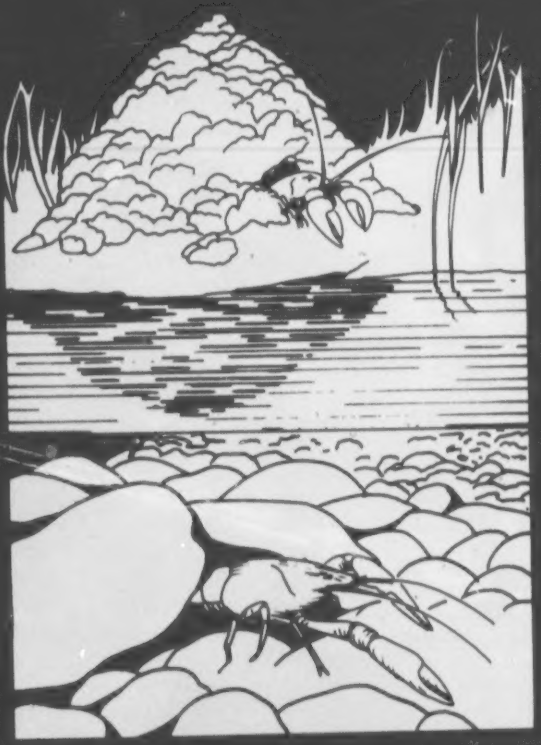
A large part of the crawdad's popularity is due to its palatability. Boiling water and a bit of dill quickly transform a day's catch into a delicious meal. Yet crawdads are even more fun to catch than to eat! They can easily be taken with inexpensive, homemade equipment. All you need are trap materials, some bait, a little ingenuity, a crawdad hole, and you are ready for *Crawdad Grab*. Take a group of kids to a crawdad hole and introduce them to crayfish behavior and food preferences! (This activity also works with crabs.)



BUILD A TRAP THAT WILL CATCH CRAWDADS

MEET THE CRAWDAD

There are over 200 different kinds of crawdads or crayfish in North America alone. You can find crayfish in a variety of freshwater aquatic sites, from swamps to rivers. Crayfish prefer cool water. You can find them among rocks, snags, and other bottom objects, including manmade debris. Crawdads are scavengers that feed on almost any kind of edible matter they encounter. Tying a fish head or other bait to a piece of string and dropping it into likely looking crawdad holes will quickly attract crawdads if any are present. (No hooks are necessary.)



MATERIALS

For each fisherman:

1 wire coat hanger
1 crawdad container (milk carton, bucket, or dishpan)

Trap and bait materials for the group:

- sticks, twigs, and other natural non-living materials
- weights (rocks)

1 old bed sheet or burlap, nylon stockings, hardware cloth (old screen-door material), or other types of cloth

- soft wire (or "twistums" often used to close plastic bags)

1 pair of scissors every 4 kids
1 pair of pliers every 4 kids
1 pair of wire cutters every 4 kids

- rubber bands
- string or twine (enough for each trap to reach bottom of fishing hole)
- old cans and milk cartons
- several different baits (meat or fish scraps, bones, pork rind, liver, bacon, fish guts, clams, etc.)

For the FOLLOW THROUGH:

1 bottle of brightly colored fingernail polish

CRAWDAD GRAB

PREPARATION

1. **Safety**. When working around aquatic sites OBIS suggests using the buddy system. (See the *Leader's Safety Kit* folio.)
2. **Site**. Choose a site with gently sloping banks and plenty of elbow room. Try to avoid deep, swiftly flowing streams and rivers. The best site would have snags, tree roots, or rocks for crayfish to hide among. Use the tied bait technique mentioned above to make sure your site contains crawdads.
3. Plan one long period (two hours) or two short periods (one hour each) for *Crawdad Grab* to allow ample time for trap experimentation and fishing.
4. Gather enough trap and bait materials to permit each team to try several different trap designs. The group can help you gather the suggested materials.
5. If your group has gastronomic designs, check your local fish and game regulations for possible restrictions and consult with a local crawdad gourmet for recipes. If you don't plan to eat the crawdads, be sure to return them to the crawdad hole.

ACTION

1. Announce to the participants that they have gathered on the banks of a crawdad hole to hold the first annual Crawdad Grab!
2. Explain that the Crawdad Grab is a contest to see who can catch the most crawdads. The participants may fish, trap, or both.
3. Divide the group into teams of two and initiate the buddy system.
4. Spread out the trap and bait materials and let the contest begin.
5. Encourage the teams to try several different trap designs, baits, and different areas of the crawdad hole. Lend assistance if needed.
6. Hand out crawdad containers and mention that captured crawdads should be kept moist and out of direct sunlight. Place captured crayfish in just enough water to keep their undersides wet. Crayfish may suffocate if they are completely submerged. To keep them cool, periodically replace the container water with fresh water.
7. When you have about fifteen minutes remaining, tally up the captured crayfish and announce the winner of the crawdad grab.

CONTEST HIGHLIGHTS

Gather to discuss contest highlights and discoveries. Ask the contest winner to describe his/her winning crawdad techniques.

☐ Did the crayfish prefer certain baits?
☐ Which trap designs were most successful? Why?
☐ Which fishing techniques worked the best?
☐ Where were the best fishing spots?
☐ How do crayfish move?
☐ How do the crayfish react when you try to pick them up?
☐ How do the crayfish react to each other?
☐ How does a crawdad eat? Where is its mouth?

FOLLOW THROUGH

Mark and Recapture. Discover if crawdads stay in the same area. Use a bottle of brightly colored nail polish to mark captured crayfish. Dry off their backs and apply a small spot of polish. Keep track of the number of crayfish that are marked and released. Hold another Crawdad Grab on a different day to see how many of the marked crawdads you can recapture.

FURTHER INVESTIGATIONS

	Set
Attract a Fish	*II*
Hopper Circus	*II*
Water Breathers	*II*
Animal Movement in Water	*I*

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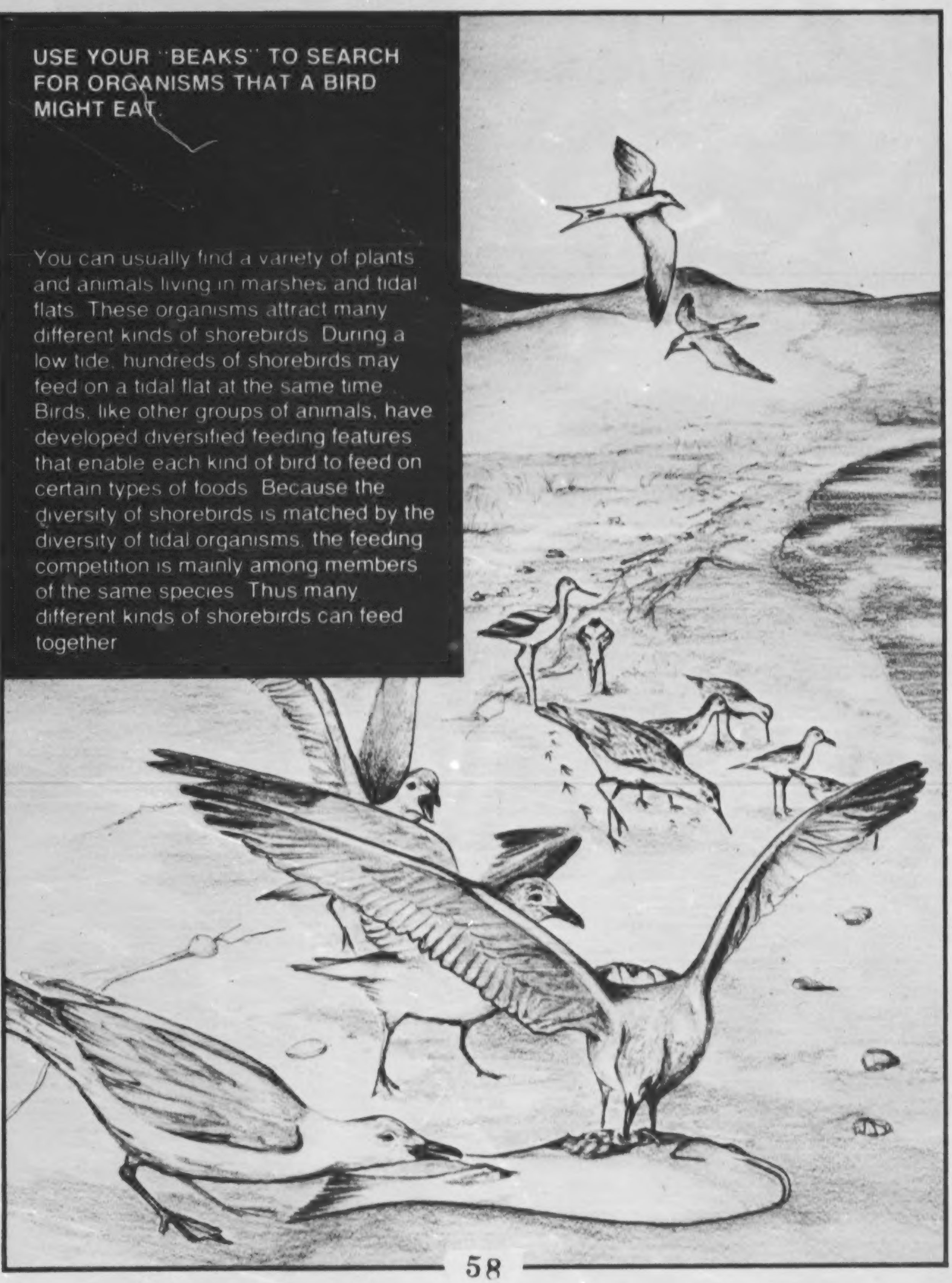
USE YOUR "BEAKS" TO SEARCH FOR ORGANISMS THAT A BIRD MIGHT EAT.

You can usually find a variety of plants and animals living in marshes and tidal flats. These organisms attract many different kinds of shorebirds. During a low tide, hundreds of shorebirds may feed on a tidal flat at the same time. Birds, like other groups of animals, have developed diversified feeding features that enable each kind of bird to feed on certain types of foods. Because the diversity of shorebirds is matched by the diversity of tidal organisms, the feeding competition is mainly among members of the same species. Thus many different kinds of shorebirds can feed together.



In this activity the youngsters pretend to be shorebirds searching for food. Each participant receives a "beak" and a "stomach." The kids use their "beaks" to search for organisms that a bird might eat, and place them in their "stomachs." After searching for food, the "birds" gather to examine the contents of their "stomachs." The activity closes with the kids trying to discover how real shorebirds find their food. This is a good introductory activity for a marsh or a tidal flat.

MATERIALS

For each individual:

- 1 beak (trowels, spoons, popsicle sticks, etc.)
- 1 stomach (milk-carton half or other suitable container)
- ● lump of clay, crayons and paper (for making impressions of organisms that would be harmed by removal)

PREPARATION

Choose any area where shorebirds frequently feed, but avoid sites with deep, soft mud. For saltwater sites, obtain a tide table and choose a low tide period for the activity. Ask the participants to wear old clothes and shoes for the activity. Before conducting this activity, check the fish and game regulations for your area to determine possible restrictions.

BRING 'EM BACK ALIVE!

As you begin, stress the importance of being careful with all living organisms. When organisms are collected for observation, they should be returned after the investigation to the exact place they were found. Some organisms, such as mussels, barnacles, and kelp, are firmly attached to solid surfaces. Instead of removing these organisms, the youngsters can make clay impressions or crayon rubbings.

To make a **clay impression** of an organism, work the clay until it is pliable and flatten it into a fat pancake. Wet the organism to keep the clay from sticking to it, then gently press the flattened clay onto the organism. Carefully remove the clay to obtain the organism's impression.

To make a **crayon rubbing**, simply place a piece of paper over the organism and, while holding the paper in place, rub a crayon over the paper to obtain an outline of the organism.

FLOCKING TO FOOD

ACTION

1. Before you reach the activity site, explain that you chose this site because it is a popular feeding place for shorebirds. Point out any visible shorebirds.
2. Upon reaching the site, define the limits and ask everyone to stay within the boundaries during the activity. (Fifty meters of shoreline should be adequate.)
3. Explain that today the youngsters are going to be shorebirds searching for something to eat.
4. To change the youngsters into shorebirds, hand each kid a beak and a stomach. Discuss the investigation procedure with the group. (See the BRING EM BACK ALIVE section.) Point out the availability of clay, crayons, and paper for recording organisms that would be injured by removal.
5. Challenge the kids to use their beaks to search for organisms that a shorebird might eat. Explain to the kids that they must search with their beaks but they can use their hands to pick up the organisms and temporarily place them in their stomachs.
6. While keeping an eye on the group, grab a beak and stomach yourself and join in.
7. After twenty to thirty minutes, call your birds back to compare the contents of their stomachs. By placing the stomachs on the ground, you can easily examine the different foods.

FOOD FOR THOUGHT

While the participants are comparing the organisms in their stomachs, raise some of the following questions.

Which organisms were easiest to find? Easiest to catch?

What were the best hunting areas like?

Were most of the animals found above or beneath the ground?

Where were most of the plants found?

Direct each participant to choose one of the organisms from their stomachs and ask the group what kind of beak would be best suited to capture that organism. Suggest that the kids draw their beak ideas in the mud or sand. Ask some of the kids to explain their beak designs.

Before starting the final investigation, ask the kids to return the organisms to the places they were found. Ask the youngsters to watch how the animals dig back into the sand or mud.

FOOD DETECTION

If time permits, ask the group how shorebirds might detect burrowing animals that live beneath the surface. Do they see, hear, feel, or smell them? Send the kids back into the site to use their senses to pinpoint the location of burrowing animals. **Hint:** Search for evidence of bird-feeding activity, e.g., tracks, droppings, probe holes, broken shells, etc. Hand out digging "beaks" for checking out selected locations.

FOLLOW THROUGH

1. Repeat the activity at a different site and compare the food sources found.
2. By watching different shorebirds' feeding behavior can you determine what they are eating?

WHAT TO DO NEXT

	Set
Crawdad Grab	*II*
Hopper Circus	*II*
Adaptation – Predator-Prey	*I*
Animal Movement in Water	*I*

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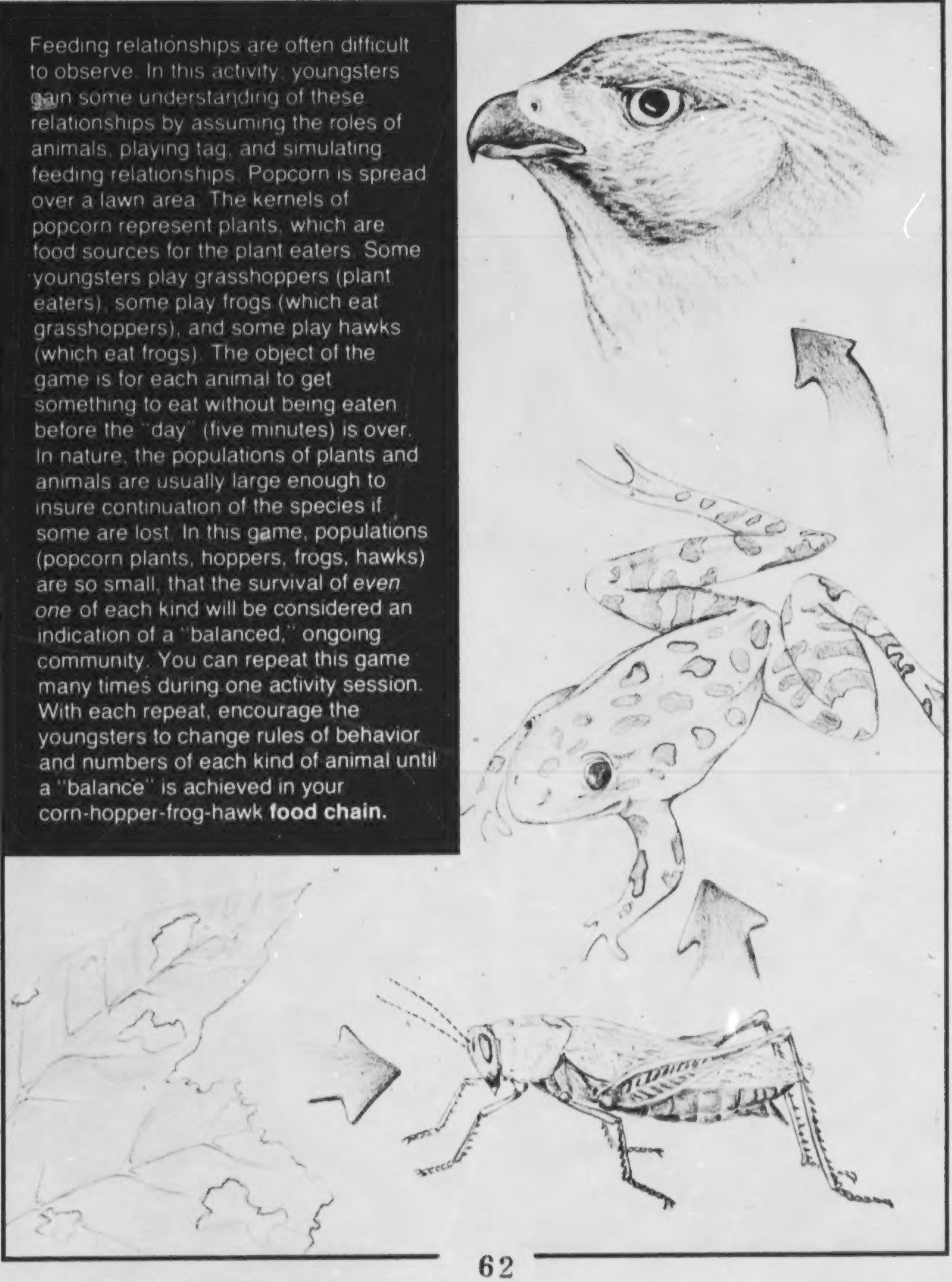
Feeding relationships are often difficult to observe. In this activity, youngsters gain some understanding of these relationships by assuming the roles of animals, playing tag, and simulating feeding relationships. Popcorn is spread over a lawn area. The kernels of popcorn represent plants, which are food sources for the plant eaters. Some youngsters play grasshoppers (plant eaters), some play frogs (which eat grasshoppers), and some play hawks (which eat frogs). The object of the game is for each animal to get something to eat without being eaten before the "day" (five minutes) is over. In nature, the populations of plants and animals are usually large enough to insure continuation of the species if some are lost. In this game, populations (popcorn plants, hoppers, frogs, hawks) are so small, that the survival of *even one* of each kind will be considered an indication of a "balanced," ongoing community. You can repeat this game many times during one activity session. With each repeat, encourage the youngsters to change rules of behavior and numbers of each kind of animal until a "balance" is achieved in your corn-hopper-frog-hawk **food chain.**



SURVIVE AS AN ANIMAL IN A MAKE-BELIEVE FOOD CHAIN BY GETTING ENOUGH TO EAT WHILE AVOIDING BEING EATEN YOURSELF.

MATERIALS

For each animal:

- sashes about 20 cm x 100 cm (see PREPARATION section for number)
- 1 plastic bag stomach (sandwich bag)

For the group:

4-5 liters of popped corn
1 data board
1 marking pen
1 kitchen timer with bell
1 roll of 1" masking tape

PREPARATION

At least ten youngsters are needed for best results.

Sashes. Make the sashes from strips of cloth in three different colors. Have enough sashes for 3 4 of the group to be grasshoppers, 1 3 to be frogs, and 1 3 to be hawks. The unbalanced ratio provides the opportunity to change the population numbers in the game. Make the sashes about a meter long and 20 to 30 cm wide. Prepare stomach bags. Place a strip of masking tape across the sandwich bag so the bottom edge of the tape is 4 cm from the bottom of the bag. (See **Analysis** section of **ACTION.**)

Site Selection. A section of lawn 15 meters on a side is sufficient. The group may decide to designate potential home bases such as trees, a walk, etc., where hoppers and frogs can hide or be safe.

ACTION

Introducing food chains. Ask the participants if they know what mice eat and what eats mice. "Mice eat seeds and snakes eat mice," they may respond. Diagram the relationship they describe and introduce it as a **food chain.** (Arrows point in the direction that the food goes.)

seeds ⟶ mice ⟶ snakes

Ask the kids if they can think of other food chains, including a food chain that contains man.

Food Chain Game

1. Describe the limits of the gaming area. Spread popcorn over the area. (Save a little for later.) Tell the group that you are distributing plants that grasshoppers eat.
2. Hand out a plastic bag and a grasshopper sash (all one color) to 1/3 of your group. Tell the kids to put their "food" (popcorn) in their "stomachs" (bags) when the game starts.
3. Hand out a bag and a frog sash to a second 1/3 of the group, and hawk sashes to the last 1/3. When the game starts, frogs will try to capture (tag) hoppers, and the hawks will pursue frogs. When a frog captures a hopper, the hopper's stomach contents are transferred to the stomach of the frog. When the hawk captures a frog, he takes the frog's whole stomach. Hawks do not eat hoppers in this game.
4. State the challenge. Set the timer for five minutes and holler "Go!" The first game usually lasts only a few seconds with one of two things happening. Hoppers are gobbled up before they have a chance to forage; or the frogs are gobbled up and hoppers continue to eat popcorn and get fat.
5. **Analysis.** How many animals survive? For a hopper to survive, popcorn must fill the stomach bag to the bottom of the tape (4 cm). For a frog to survive, popcorn must fill the stomach bag to the top of the tape (6-1/2 cm). Hawks must have the equivalent of one frog with sufficient food to survive. If at least one of each kind of animal survives, you have an ongoing food chain. Return the corn to the activity area after each game.
6. **Instant Replay:** learning by making rule variations. Ask for suggestions on rule changes that might result in more of a balance after the five-minute day. Usually *one* rule is changed for each replay. When you have settled on your new rules, play again. Suggest these changes if the kids can't offer any.
   - a. Change the number of hoppers and/or frogs and/or hawks.
   - b. Let each hopper come back as another hopper once after being captured and transferring "stomach contents."
   - c. Provide a "safety zone" for frogs and/or hoppers where they can be safe.
   - d. Timed releases. Let hoppers go first to forage unmolested. One minute later release the frogs, and later the hawk(s).
   - e. Spread out more popcorn.

Note: You may want to eliminate bickering over who will be which organism by drawing markers from a hat to assign roles for replays.

FOOD FOR THOUGHT

After each game, analyze the results. How many hoppers got a full stomach? How many frogs? The hawks? Encourage youngsters to compare game results after each rule change, and to comment on how the game "balance" compares with balance in the real world. In nature's balance, there are more plants than plant eaters and more plant eaters than animal eaters. You might wish to graphically represent the results on your data board.

☐ What would happen if there were only half as many popcorn plants? What would happen to the animal that depends on those plants?

☐ If there were no frogs, what would happen to the plant population? The hopper population? The hawk population?

☐ Do hawks need plants to survive? Explain!

☐ Can you describe some food chains that *you* are part of?

☐ Are there any plants or animals that are *not* part of any food chains?

MORE LINKS IN THE CHAIN

☐ Look for evidence of plants being used for food. Can you find the animals responsible? Make sun prints of the evidence you find. (See *Habitat Sun Prints*, Set I.)

☐ Find some ladybugs, or better yet, some ladybug larvae. Put them in with some aphids in a small container and observe. Describe the food chain they are part of.

WHAT TO DO NEXT

	Set
Attract a Fish	*II*
A Better Fly Trap	*II*
Flocking to Food	*II*
Gaming in the Outdoors	*II*

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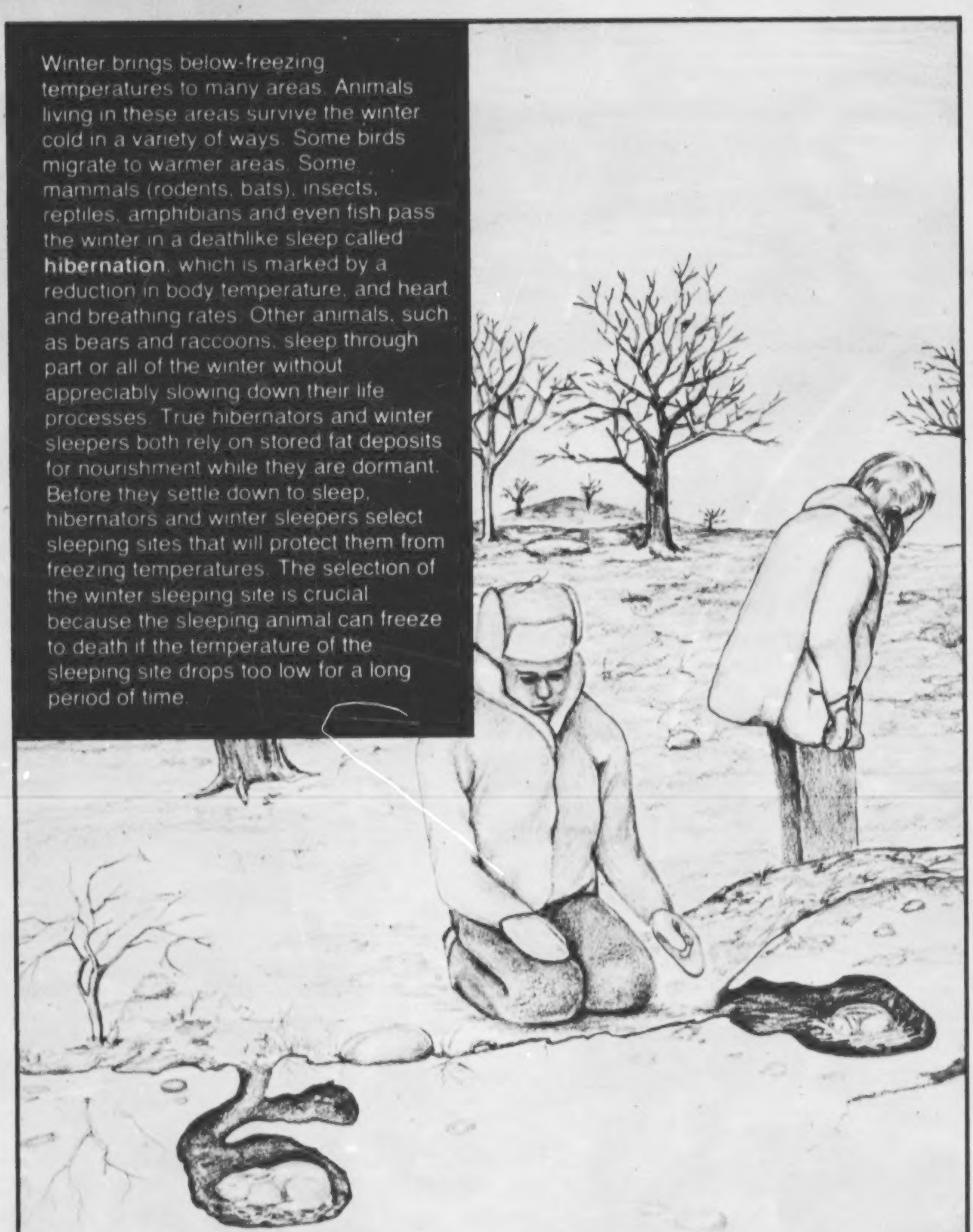
Winter brings below-freezing temperatures to many areas. Animals living in these areas survive the winter cold in a variety of ways. Some birds migrate to warmer areas. Some mammals (rodents, bats), insects, reptiles, amphibians and even fish pass the winter in a deathlike sleep called **hibernation**, which is marked by a reduction in body temperature, and heart and breathing rates. Other animals, such as bears and raccoons, sleep through part or all of the winter without appreciably slowing down their life processes. True hibernators and winter sleepers both rely on stored fat deposits for nourishment while they are dormant. Before they settle down to sleep, hibernators and winter sleepers select sleeping sites that will protect them from freezing temperatures. The selection of the winter sleeping site is crucial because the sleeping animal can freeze to death if the temperature of the sleeping site drops too low for a long period of time.



FIND AREAS THAT WOULD PROTECT A WINTER ANIMAL FROM FREEZING.

In this activity, the participants locate places within the activity site that would protect a winter sleeper from freezing to death. The kids test their choices by placing imaginary winter animals (cups of liquid gelatin) in the selected areas and noting how long it takes for the gelatin to set. At the end of the activity, the participants hold a freeze-off to discover which area provides the most protection, i.e., allows for the longest gelatin setting time.

MATERIALS

For each kid:

5 film cannisters (35 mm, metal or plastic OK, but all should be the same kind), or small paper cups (3-oz bathroom dispenser cups) or plastic pill vials
5 small paper cards (to cover containers that are buried)
1 digging tool (hand trowel)
1 quart of liquid gelatin (for every six kids)

For the group:

1 watch with second hand
1 thermometer

35 mm film cannisters can usually be obtained free from camera shops.

PREPARATION

Any outdoor site with interesting nooks and crannies is a good activity site. Trees, bushes, mounds of soil or leaves, wood or rock piles, hollow trees, banks, etc., make the activity more interesting by offering a variety of possible sleeping spots. Pick a day when the air temperature is 5 C (41 F) or lower. Just before the activity, mix the gelatin according to the directions on the package. Liquid gelatin can be carried to the site in thermos jugs and poured out before each trial. Mark the film cannisters at the half-full level so the kids can pour equal amounts of gelatin into the cups. (Masking tape can be used on plastic cans to facilitate marking.) The temperature of the liquid gelatin should be between 10 C (50 F) and 15 C (59 F) for the start of the freezing trials. Keep track of its temperature with your thermometer. The following table lists the approximate gelling time for a half-filled gel cup at a starting temperature of 10 C to 15 C. Unflavored gelatin sets faster than flavored gelatin.

Outside Temperature	Approximate Unprotected Setting Time
-20 C to -10 C (-4 F to 14 F)	5 to 10 min
-10 C to -5 C (14 F to 23 F)	10 to 15 min
-5 C to 0 C (23 F to 32 F)	15 to 20 min
0 C to 5 C (32 F to 41 F)	20 to 30 min

ANIMAL ANTI-FREEZE

At temperatures below -20°C, you can use plain water at 10°C instead of gelatin if you wish. Before running the activity, experiment with various gelatin starting temperatures to arrive at a starting temperature that will yield about a ten-minute gelling time for the unprotected areas of your site. By using half the amount of water called for in the directions, you can make a more concentrated gelatin which can be used on warmer days, when the temperature is 6°C to 12°C (43°F to 53°F).

Make sure the kids dress warmly. On a very cold day, you may want to carry a jug of hot cocoa or soup.

ACTION

1. Explain that a hibernating animal (chipmunk) or winter sleeper (bear) must select a sleeping spot that will provide protection from the winter cold. If the temperature of the sleeping spot falls too low, the sleeping animal may freeze to death. Ask the participants to imagine that they are animals looking for winter sleeping spots that will protect them from freezing. They will test their selections by placing gelatin animals (hold up a gel cup) in the sleeping spots and noting how long it takes for the animals to freeze (get too firm to pour).

2. Give your imaginary hibernators five to ten minutes to select likely sleeping spots. Hand out the digging tools and explain that burrowing and building with non-living materials is permitted. After describing the boundaries of the activity site, let the kids search for sleeping spots.

3. Call the participants together and hand out one gelatin animal to each kid. When everyone is next to his or her sleeping spot, shout, "Put your animals in place!" and start the timing. You should set one gelatin animal out in the open (unprotected) at the same time to serve as a control. The trial ends when most of the gelatin animals freeze. Remind the kids that their animals are frozen when the gelatin will not pour. While the kids are waiting for their animals to set, encourage them to visit each other's sleeping spots.

4. Hold several trials to allow your imaginary hibernators to try out several sleeping spots.

5. After two or three trials, announce that it is time for a freeze-off between the better spots. Ask each kid to select his/her trial sleeping spot that offers the best protection from the cold. Hand out gelatin animals and hold the freeze-off to discover which spot provides the most protection, i.e., allows the gelatin to remain a liquid the longest. This time the trial runs until *only one* gelatin animal (the winner) is still in the liquid state.

CHILLING THOUGHTS

☐ Why would a gelatin animal always eventually freeze in sub-freezing temperatures, but a rabbit would not?

☐ If you were stranded in a winter storm without a fire how could you keep from freezing?

FOLLOW THROUGH

1. Provide insulating materials such as feathers, wool, paper, and man-made insulators and repeat the activity.
2. How does constant stirring of the gelatin affect its gelling time?
3. Using the same containers, double the volume of liquid gelatin. What happens? After experimenting with the gelling time of different volumes of gelatin, ask the kids if they think small animals or large animals might have a more difficult time of conserving their heat.

WHAT TO DO NEXT

	Set
Birdfeeder	*II*
Sensory Hi-Lo Hunt	*II*
Who Goes There?	*I*

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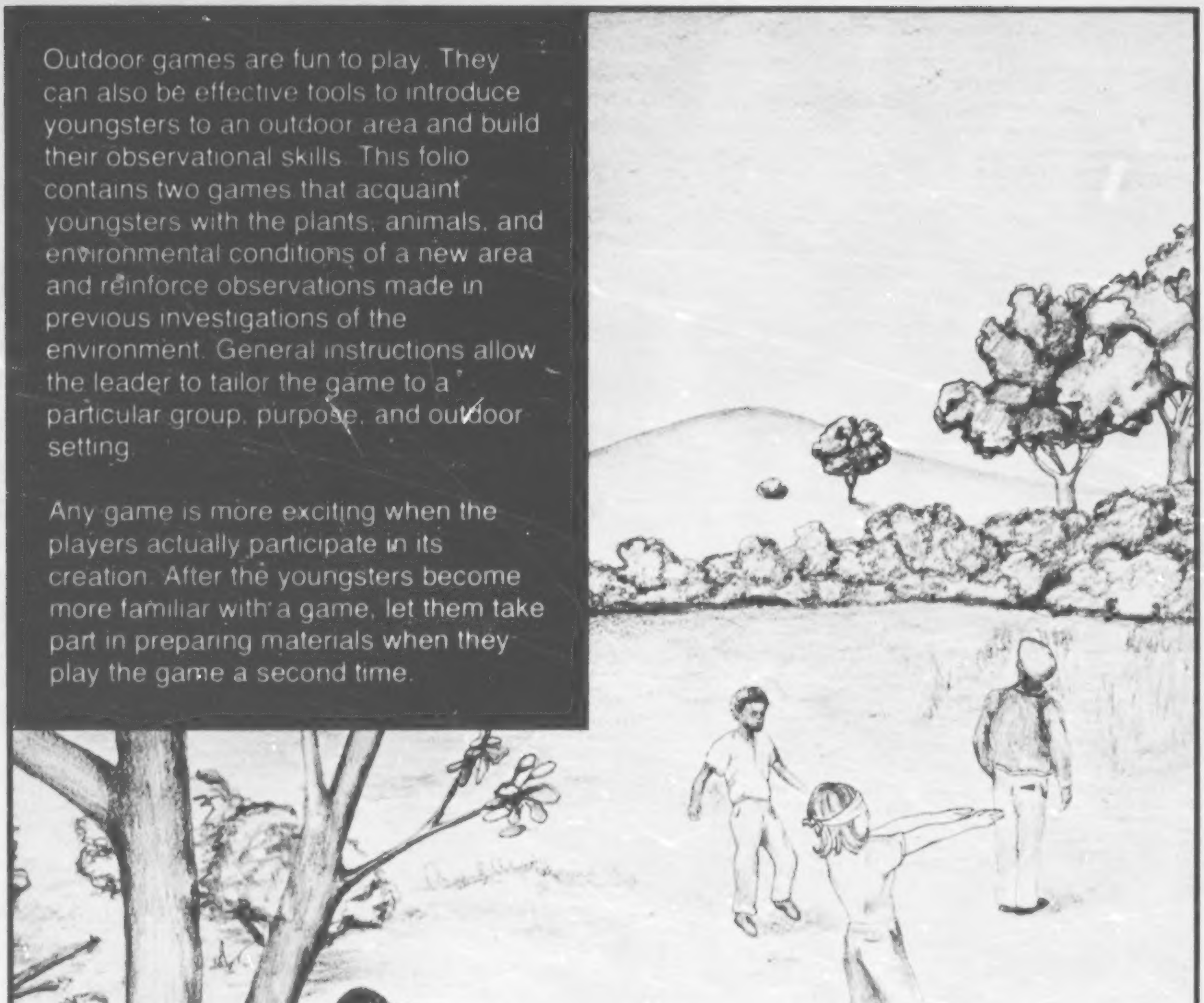
Outdoor games are fun to play. They can also be effective tools to introduce youngsters to an outdoor area and build their observational skills. This folio contains two games that acquaint youngsters with the plants, animals, and environmental conditions of a new area and reinforce observations made in previous investigations of the environment. General instructions allow the leader to tailor the game to a particular group, purpose, and outdoor setting.

Any game is more exciting when the players actually participate in its creation. After the youngsters become more familiar with a game, let them take part in preparing materials when they play the game a second time.



I. A HUNTING

A version of the old Scavenger Hunt, this game focuses on natural objects found in an outdoor site, and provides a good background for the second game **Out-of-Place Hunt.**

MATERIALS

For each kid (or team of two):

5-8 index cards (Hunt Cards)
1 piece of thick string or
  yarn (30 cm long)
1 plastic bag (to hold finds)
1 pencil or crayon
1 roll of transparent tape
2 small plastic lunch bags
2 rubber bands
1 hand lens (optional)

For Special Hunts (Optional):

For materials needed to do the special hunts, see the following technique cards in the *OBIS Toolbox* folio

Ink Print
Crayon Rubbing
Sun Print

PREPARATION

1. **What to hunt for.** The hunt card items should reflect the nature of the area. The hunt cards may be general or they may focus on one theme such as animal foods or natural shapes.

For example

General Hunt

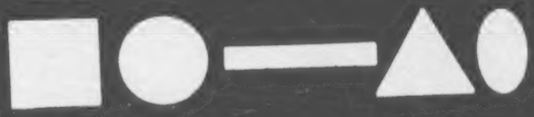
Find a seed that travels by wind
Find soil that feels like clay
Find an animal home
Find an insect on a plant
Find a leaf with parallel veins

Animal-Food Hunt

Find food for a bird
Find food for a squirrel
Find food for an insect
Find food for a snail
Find food for a frog

Natural-Shape Hunt

Find natural objects that have these shapes



2. **Making the Hunt Cards.** Prepare a set of five to eight hunt cards for each individual or team. Each card in a set describes one item. The cards can take the form of

a. a word or written description
b. a picture
c. both a written description and a picture
d. the item itself attached to the card.

Punch a hole in the center of one edge of a set of cards and tie together with string. With the rest of the string, make a loop for the hunter's hand. Prepare several different sets for the group to use. The cards are easy to make and take little time. If you have a duplicating machine handy, you can make one set and duplicate enough for all the participants.

3. **Recording Finds.** Use one or several methods, depending on the hunt cards used.

a. Collect the item or a small representative piece of the item and place it in a bag or tape it to the hunt cards.
b. Draw (on the hunt card) a picture of the item.
c. Make a **crayon rubbing** of the item.
d. Make an **ink print** of the item.
e. Make a **sun print** of the item.

ACTION

1. Introduce the hunt and the methods of recording the finds.
2. Give each individual or team a set of hunt cards.
3. Challenge the group to search the area and find the items indicated.

FOLLOW THROUGH

Share the finds. Were any items not found?

Have each team create a story that incorporates its finds.

Place hunt cards in one pile and finds in another. Try to discover which find goes with each card.

Have the players prepare hunt cards for other teams and go again!

II. OUT-OF-PLACE HUNT

This game requires careful observation and the knowledge of what is to be expected in an area. Because the hunters search for out-of-place items, this game is more successful if it follows **A Hunting**.

Set up the Out-of-Place Hunt Trail and allow individuals or small groups (two or three kids) to walk the trail during free times or during other outdoor activities.

MATERIALS

For each individual:

1 index score card (5" x 8") with trail outline (See PREPARATION section.)
1 pencil

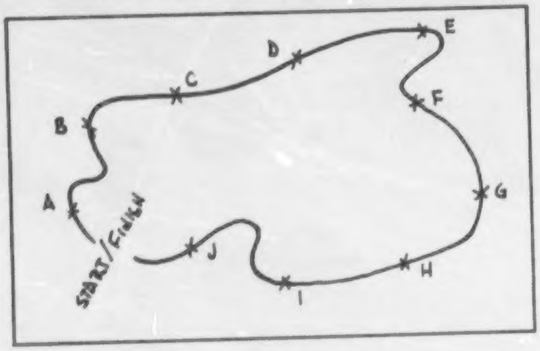
For the group trail:

1 roll of tape
1 ball of string
1 pair of scissors
• box of natural objects: fruit, leaves, shells, rocks, sand
10-12 trail markers (stakes or flagging, index cards, marking pen)

PREPARATION

1. Set up the trail before meeting with the youngsters. Mark a circular path through a previous activity area, placing stakes or flagging with lettered index cards at intervals of three to four meters. If a clear foot path is not present, use string to indicate the exact trail.

2. Along the path, place natural objects in areas where they do not belong. For instance, place an apple in a berry bush, berries in an oak seedling, an oak leaf in an elm tree, or make a damp area on dry ground in bright sunlight.
3. Prepare score cards by outlining the trail on index cards and indicating the location of the lettered intervals.



ACTION

Play the game.

1. Tell the group you have made some changes in the area. If the kids know the area well, they will be able to detect the objects that are out of place. Give them one example.
2. Tell the group that only two to three hunters can follow the trail at a time. When a youngster wants to hunt, he or she obtains a score card and pencil from the leader and waits for the leader's OK to start. Explain that each hunter records on the score card the number of out-of-place items in each of the lettered intervals. All discoveries should be kept secret until the end of the hunt.
3. When everyone has completed the hunt, ask for the number of out-of-place items discovered, and compare score cards.
4. As a group, walk the circular path again and have the hunters point out the items they found. Point out any items the youngsters missed.

Play the game again.

Divide the group into two teams. Have each team make a trail of out-of-place objects for the other team. Provide natural objects or have the teams collect them from surrounding areas.

FOLLOW THROUGH

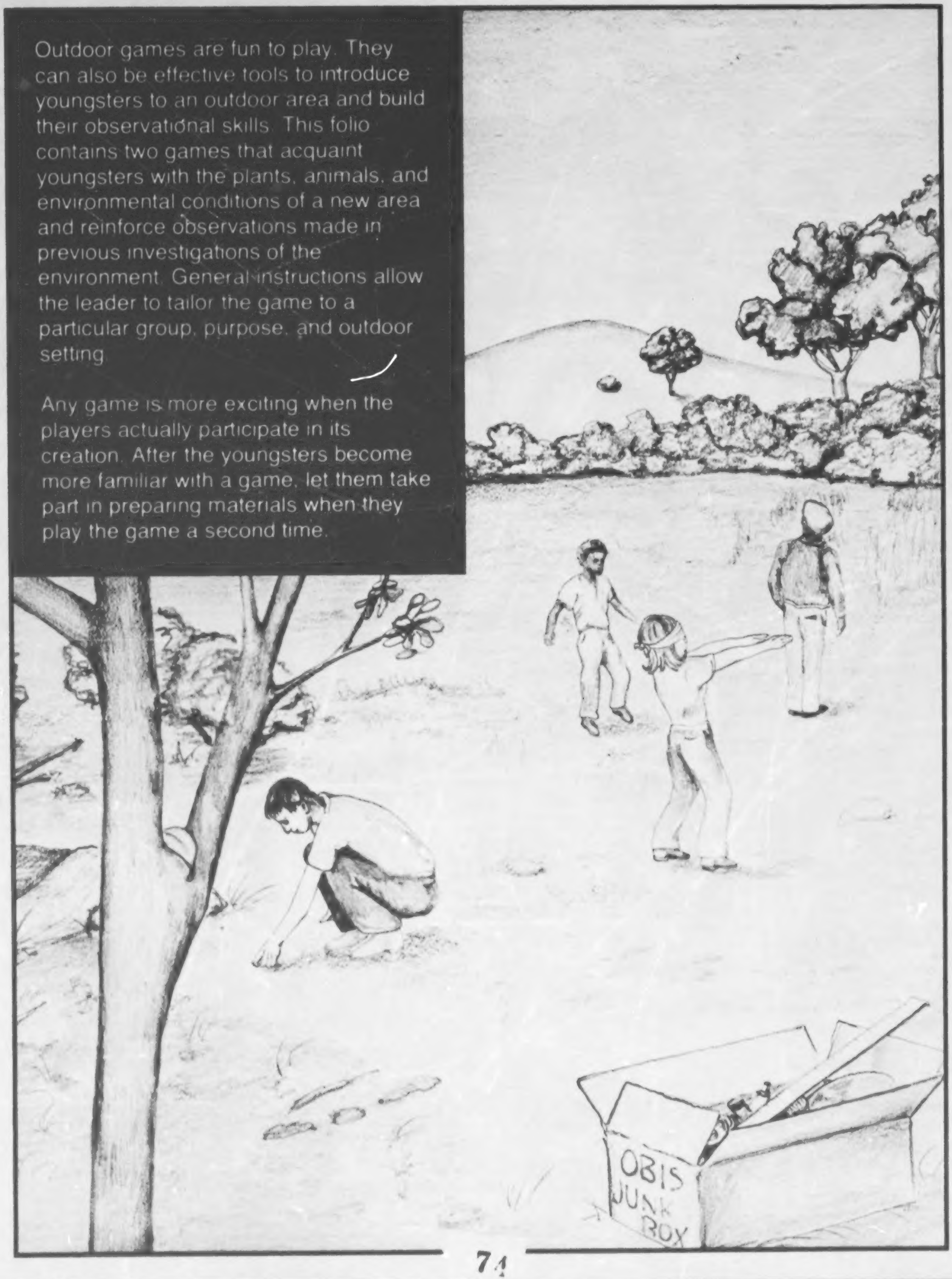
In any natural outdoor setting, there are curious, unexpected things to find. Some examples are a mound of soil, a piece of litter, one defoliated bush, footprints, or tracks. A good outdoor hunter can use these curiosities as clues to the interactions that have occurred in the area, whether they be gophers digging burrows or insects eating leaves on a bush. Have the group hunt for these natural things in their activity area. What do these curious clues tell you?

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

Outdoor games are fun to play. They can also be effective tools to introduce youngsters to an outdoor area and build their observational skills. This folio contains two games that acquaint youngsters with the plants, animals, and environmental conditions of a new area and reinforce observations made in previous investigations of the environment. General instructions allow the leader to tailor the game to a particular group, purpose, and outdoor setting.

Any game is more exciting when the players actually participate in its creation. After the youngsters become more familiar with a game, let them take part in preparing materials when they play the game a second time.



I. A HUNTING

A version of the old Scavenger Hunt, this game focuses on natural objects found in an outdoor site, and provides a good background for the second game, **Out-of-Place Hunt**."

MATERIALS

For each kid (or team of two):

5-8 index cards (Hunt Cards)
1 piece of thick string or
  yarn (30 cm long)
1 plastic bag (to hold finds)
1 pencil or crayon
1 roll of transparent tape
2 small plastic lunch bags
2 rubber bands
1 hand lens (optional)

For Special Hunts (Optional):

For materials needed to do the special hunts, see the following technique cards in the *OBIS Toolbox* folio.
Ink Print
Crayon Rubbing
Sun Print

PREPARATION

1. **What to hunt for.** The hunt card items should reflect the nature of the area. The hunt cards may be general or they may focus on one theme such as animal foods or natural shapes.

For example:

General Hunt

Find a seed that travels by wind
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Find food for a squirrel
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Find food for a snail
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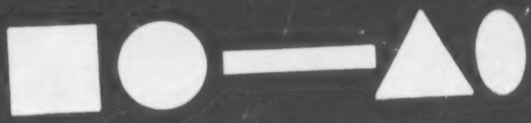
Natural-Shape Hunt

Find natural objects that have these shapes.



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Set up the Out-of-Place Hunt Trail and allow individuals or small groups (two or three kids) to walk the trail during free times or during other outdoor activities.

MATERIALS

For each individual:

1 index score card (5" x 8") with trail outline (See PREPARATION section.)
1 pencil

For the group trail:

1 roll of tape
1 ball of string
1 pair of scissors
- box of natural objects: fruit, leaves, shells, rocks, sand
10-12 trail markers (stakes or flagging, index cards, marking pen)

PREPARATION

1. Set up the trail before meeting with the youngsters. Mark a circular path through a previous activity area, placing stakes or flagging with lettered index cards at intervals of three to four meters. If a clear foot path is not present, use string to indicate the exact trail.

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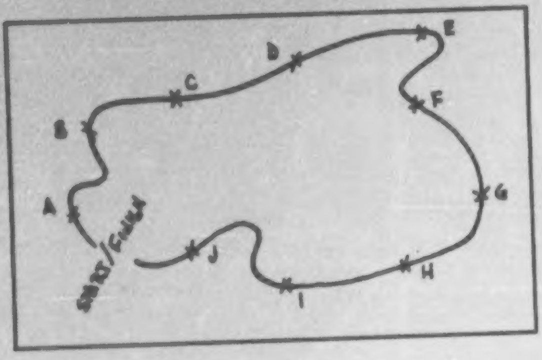

ACTION

Play the game.

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Play the game again.

Divide the group into two teams. Have each team make a trail of out-of-place objects for the other team. Provide natural objects or have the teams collect them from surrounding areas.

FOLLOW THROUGH

In any natural outdoor setting, there are curious, unexpected things to find. Some examples are a mound of soil, a piece of litter, one defoliated bush, footprints, or tracks. A good outdoor hunter can use these curiosities as clues to the interactions that have occurred in the area, whether they be gophers digging burrows or insects eating leaves on a bush. Have the group hunt for these natural things in their activity area. What do these curious clues tell you?

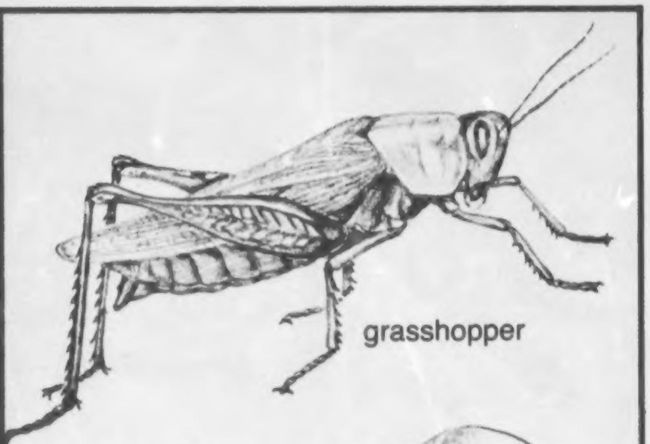
Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

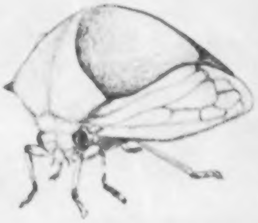
Supported by a Grant from the National Science Foundation

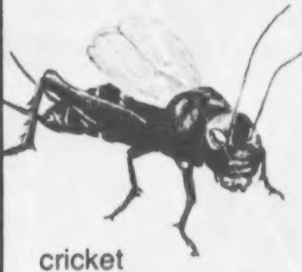
The stars of *Hopper Circus* can be any common hopping animals that live in your area. You can use grasshoppers, crickets, frogs, toads, or beach hoppers (sand fleas) in your circus. Invite a group of kids to a hopper circus to explore hopper behavior.

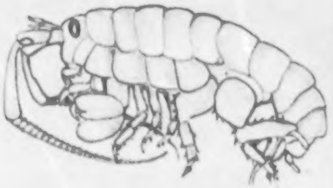
STAGE A HOPPER CIRCUS AND INVESTIGATE HOPPER BEHAVIOR.

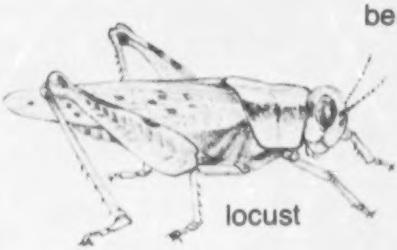
The circus opens with a brief search to locate hoppers. After the search, each participant or buddy team selects a "Side-Show Card" and investigates one aspect of hopper behavior. Anyone who completes one investigation can open a new side show by trading the completed card for a new one. Following the side shows is the main event: The Hopper Race!

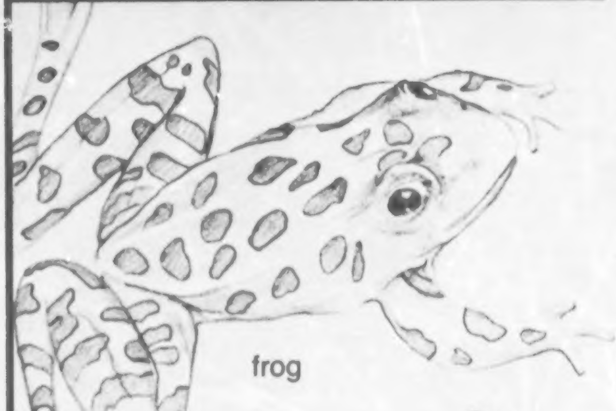

grasshopper

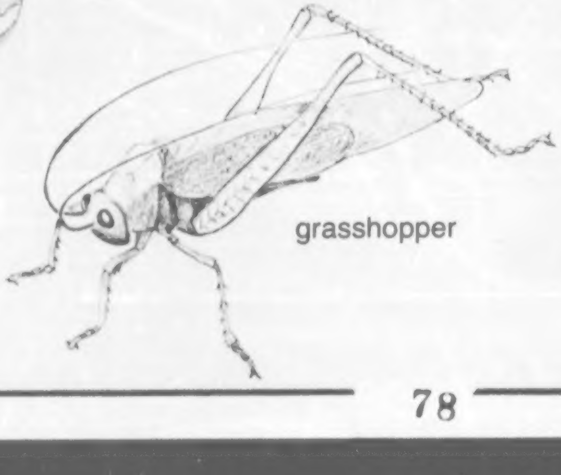

leaf hopper

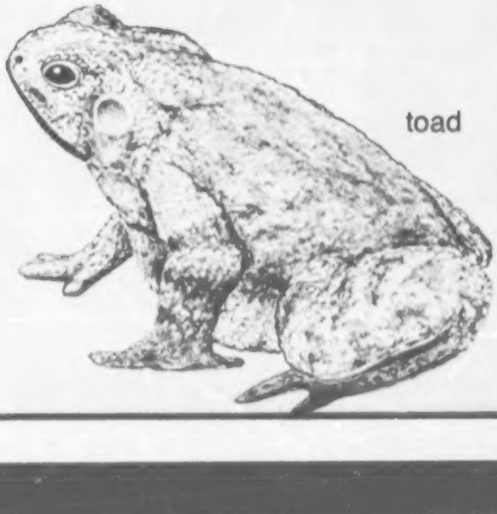

cricket


beach hopper


locust


frog


grasshopper


toad

MATERIALS

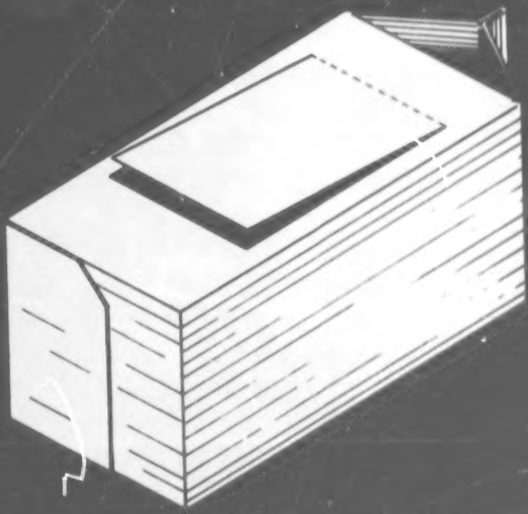
For each team of two:

1 half-gallon milk carton (rinsed out)

For the group:

4 light-response testers (milk cartons with cut-out hinged flaps)
1 tray of ice cubes
1 stop watch or watch with second hand
1 sheet of red gel
1 bucket (for collecting water)
6 meter tapes.
2 sticks (any size)
2-3 meters of string
12 nets (to catch active hoppers, e.g., grasshoppers, crickets, frogs)

Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.



PREPARATION

Site Selection. Choose a site well populated with hoppers. Open fields are good places to look for grasshoppers and crickets. You can find frogs around ponds, streams, and marshy areas, and toads in lawns. Beach hoppers (see illustration on cover) lurk under decaying seaweed and other debris above the high tide zone along the coast or in salt water bays. Before opening the circus, collect and place (without the participants seeing you) several hoppers in each of two milk-carton displays (half-gallon cartons cut in half and covered with clear plastic wrap).

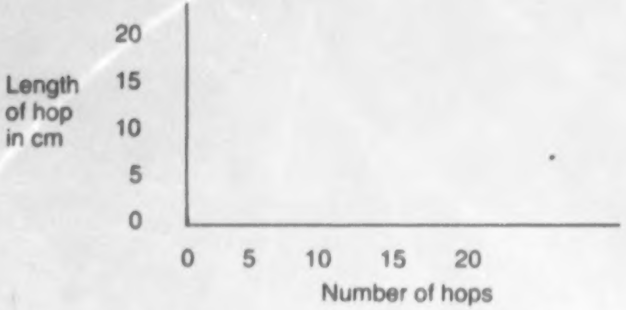
CUE THE KIDS

1. **Safety.** If you use an aquatic site, you would be wise to use the buddy system. OBIS does not suggest going into the water, but for safety reasons find out who the nonswimmers are and keep a particularly close eye on them.
2. **Bring 'em Back Alive.** Before the participants open the circus, ask them for ways to investigate living organisms without causing them harm. Stress the importance of being careful with all living organisms. You should retain organisms only temporarily for observation and try to return them unharmed to the place they were found.

HOPPER CIRCUS
Side-Show Card #1

Outdoor Biology Instructional Strategies

Distance. Does the distance a hopper hops (in one hop) change as it hops more and more?



HOPPER CIRCUS
Side-Show Card #2

Outdoor Biology Instructional Strategies

Slope. Does your hopper tend to go uphill, across the hill, or downhill when placed on a slope?

Test three or four animals.

HOPPER CIRCUS
Side-Show Card #3

Outdoor Biology Instructional Strategies

Removal. Find a way to get hoppers out of their hiding places without touching the hoppers or their hiding places with any part of your body. Singing, crying, hot breath, water, ice, etc., are OK to try.

What works?

HOPPER CIRCUS
Side-Show Card #4

Outdoor Biology Instructional Strategies

Sight. Do the hoppers seem to have good vision? How do they react to quick movements? Slow movements? Close movements? Distant movements?

Try several hoppers. Be as quiet as possible.

HOPPER CIRCUS
Side-Show Card #5

Outdoor Biology
Instructional Strategies

Light. Do the hoppers seem to hop better in sunlight or shade?

Test several hoppers to find out.

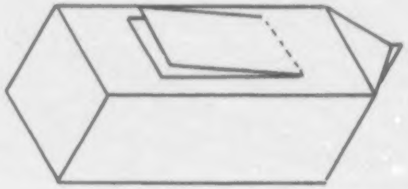
HOPPER CIRCUS
Side-Show Card #6

Outdoor Biology
Instructional Strategies

For small hoppers only!

Attraction. Put different materials into a hinged milk carton and add some hoppers. To which materials do the hoppers go? Repeat several times.

What is there about these materials that seem to attract the hoppers?

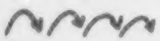


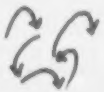
HOPPER CIRCUS
Side-Show Card #7

Outdoor Biology
Instructional Strategies

Direction. When a hopper makes a series of jumps, is each jump made in the same direction or in a variety of directions? Test ten hoppers to find out.

This or this or ?



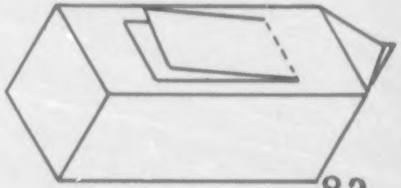


HOPPER CIRCUS
Side-Show Card #8

Outdoor Biology
Instructional Strategies

Flashing light. Get a hopper "light-response tester" from the leader. Put some hoppers into the milk-carton tester and close the lid. Keep it closed for a minute and then open it quickly to see if the hoppers react to the light.

What do they do?



HOPPER CIRCUS
Side-Show Card #1

Outdoor Biology Instructional Strategies

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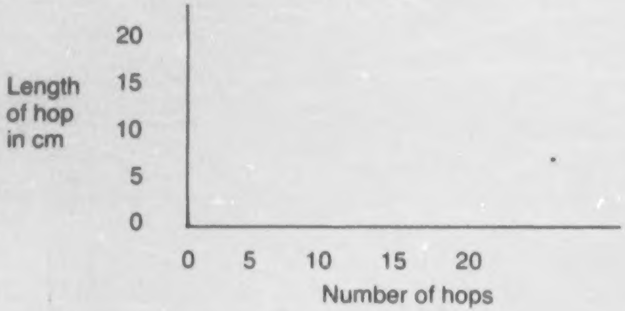

HOPPER CIRCUS
Side-Show Card #2

Outdoor Biology Instructional Strategies

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Test three or four animals.

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Outdoor Biology Instructional Strategies

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Outdoor Biology Instructional Strategies

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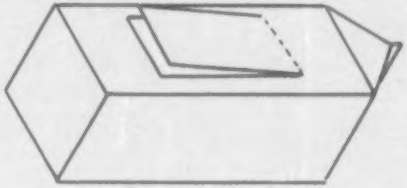

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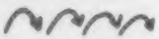

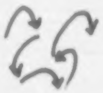

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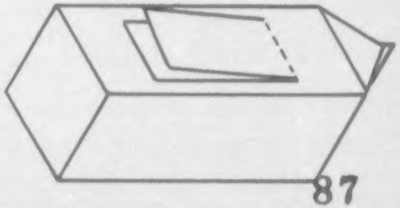
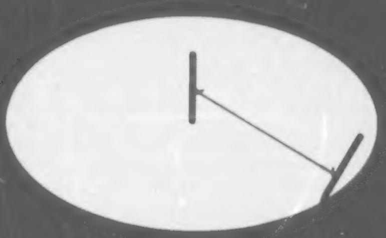


ACTION

1. At the activity site, gather for a discussion on safety and conservation. (See the PREPARATION section.)
2. Announce to the participants that they will be holding a hopper circus and investigating the behavior of hoppers.
3. Introduce the stars of the circus by passing around the two milk-carton displays of the hoppers.
4. Explain that more stars are needed before the circus can open. Point out the boundaries of the activity site and hand out milk cartons and nets. Challenge each kid to find and bring back about ten hoppers for the side shows. (The larger the hopper, the fewer you will need. With frogs and toads, each youngster need only bring back one.)
5. When the kids have captured enough hoppers, have each individual (or each team) select a side-show card.
6. Spread out the side-show materials and let the side shows begin!
7. Travel among the side shows and offer assistance where needed.

THE HOPPER RACE

Setting up the Race Course. Try to select a race course with smooth, hard-packed dirt or sand in full sunlight. Draw a circle one meter in diameter for beach hoppers, two meters for crickets, toads, small frogs, and grasshoppers, and three to four meters for large grasshoppers and frogs. Take a string half the length of your chosen diameter and tie each end around a different stick. Use this setup like a compass to draw a racing circle. Mark the center point.



The Race. When fifteen to twenty minutes remain in the time for the activity, call the participants together and announce the main event: The Hopper Race! The race will give the participants a chance to use what they have learned about hoppers.

Race Procedure. The track will run from the center of the circle to its edge. Race only two hoppers at a time. (It is difficult to keep track of more than two at a time.) To run the race, place both hoppers at the center of the circle. Start the timing as soon as one hopper begins to move, and stop the timing as soon as the first hopper reaches the edge of the racing circle. No prodding or touching the hoppers during the race allowed! Hold a runoff between the two fastest hoppers to determine the overall winner. Run as many races as time and interest permit.

CIRCUS TALK (Optional)

You may want to discuss with your participants what they learned about hoppers. You can use the race results and side-show cards to start the discussion. If you were going to breed a grand champion hopper what qualities would you look for in the parent hoppers (size, length of jump)? How far can they hop? How can you stimulate hoppers to hop without touching them? Do hoppers swim? And so on.

FOLLOW THROUGH

1. Repeat the activity with a different animal.
2. Using *Bean Bugs* (Set I) as a guide, challenge your group to take a population census of the hoppers in your activity site.

WHAT TO DO NEXT

	Set
Ants	*Individual*
Attract a Fish	*II*
Water Breathers	*II*
Bean Bugs	*I*

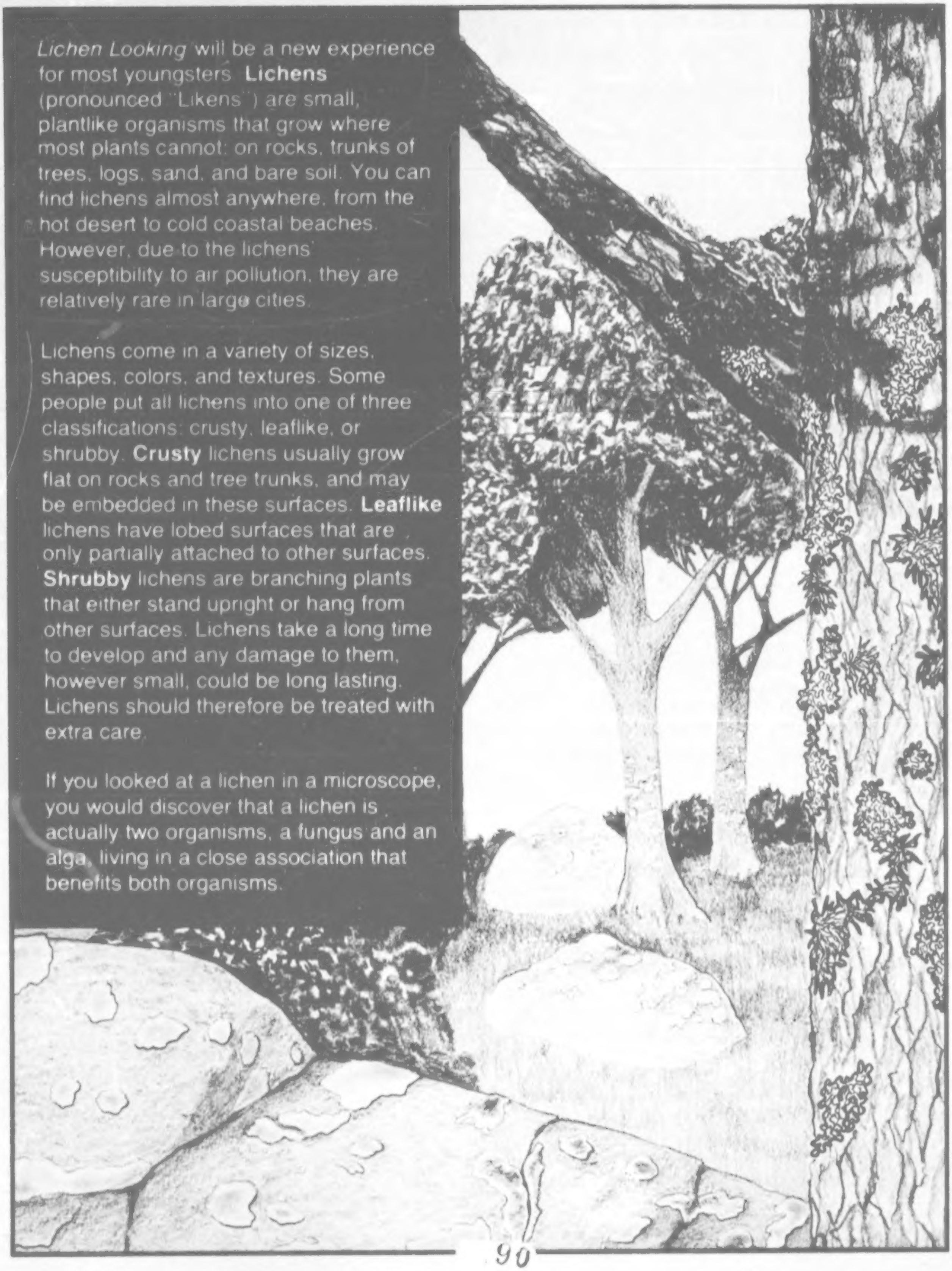
Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

Lichen Looking will be a new experience for most youngsters. **Lichens** (pronounced "Likens") are small, plantlike organisms that grow where most plants cannot: on rocks, trunks of trees, logs, sand, and bare soil. You can find lichens almost anywhere, from the hot desert to cold coastal beaches. However, due to the lichens' susceptibility to air pollution, they are relatively rare in large cities.

Lichens come in a variety of sizes, shapes, colors, and textures. Some people put all lichens into one of three classifications: crusty, leaflike, or shrubby. **Crusty** lichens usually grow flat on rocks and tree trunks, and may be embedded in these surfaces. **Leaflike** lichens have lobed surfaces that are only partially attached to other surfaces. **Shrubby** lichens are branching plants that either stand upright or hang from other surfaces. Lichens take a long time to develop and any damage to them, however small, could be long lasting. Lichens should therefore be treated with extra care.

If you looked at a lichen in a microscope, you would discover that a lichen is actually two organisms, a fungus and an alga, living in a close association that benefits both organisms.



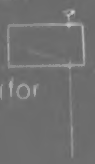
GO LICHEN LOOKING AND INVESTIGATE LICHENS.

In this activity the youngsters discover an unusual organism the lichen, and investigate locations sizes shapes colors and animals associated with lichens

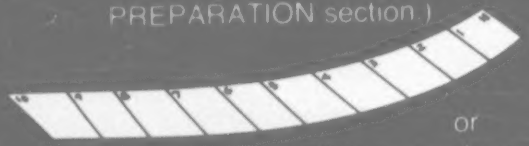
MATERIALS

For each team of two:

20 flags in an envelope (construction paper this size on straight pins)



1 masking-tape strip 25-cm long (for attaching flags to rocks)
1 set of action cards
1 sack containing the following items:
  5 pieces of wax paper (10 cm x 10 cm)
  1 felt-tip pen (fine point to write on wax paper)
  1 roll of transparent tape
  1 magnifying lens or bug box
  1 small plastic bag
  2 medium size plastic bags (1 labeled "LICHENS" and the other labeled "NO LICHENS")
  1 plastic or wax paper band (7cm x 150cm) marked off in 15-cm sections with felt marker. (See PREPARATION section.)



or

1 piece of string, 2-3 meters long, marked off in meters

For the group:

1 meter tape*
1 compass (if you aren't sure of directions)

* Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Choose an activity site containing a variety of lichens. Before the group arrives, decide which action cards are most appropriate for your site. Cards 5a and 5b are alternates for use in areas of plentiful or sparse lichen populations, respectively. If the lichens appear mainly on rocks, rather than on trees, you will need masking tape to attach the flag pins to the rocks.

Make the paper-flag pins and assemble the bags of materials before the group arrives. Action Card 5a will require the wax paper (or plastic) band marked off in 15-cm sections. (Indicate North (N) on righthand section and number sections 1 to 10 from right to left). Card 5b will use a 2-3 meter-long piece of string marked off in meters.

LICHEN LOOKING
Action Card #1

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Instructional Strategies

Lichen Colors

HOW MANY DIFFERENT COLORED LICHENS CAN YOU FIND?
Each time you discover a lichen of a new color, break off a tiny piece of the lichen no larger than this size ● and tape it to this card.

MATERIALS: tape

LICHEN LOOKING
Action Card #2

Outdoor Biology
Instructional Strategies

Lichen Shapes

HOW MANY DIFFERENT SHAPES OF LICHENS CAN YOU FIND?
Place a piece of wax paper over each different shape and trace its outline.

MATERIALS: wax paper, pen

LICHEN LOOKING
Action Card #3

Outdoor Biology
Instructional Strategies

Lichen Critters

WHAT KINDS OF ANIMALS DO YOU FIND ON THE LICHENS?
Each time you find an animal, place it in the bug box or plastic bag for observation. What do you think the animal is doing on the lichen?

MATERIALS: bug box or bag

LICHEN LOOKING
Action Card #4

Outdoor Biology
Instructional Strategies

Tree Lichens

WHICH TREES HAVE LICHENS AND WHICH DON'T?
Collect a leaf from each tree that has lichens. Keep these leaves in the "LICHEN" bag.

Collect a leaf from each tree that does not have lichens. Keep these leaves in the "NO LICHENS" bag.

What features of some trees might prevent lichen growth on the bark?

MATERIALS: 2 LABELED BAGS

LICHEN LOOKING
Action Card #5a

Outdoor Biology
Instructional Strategies

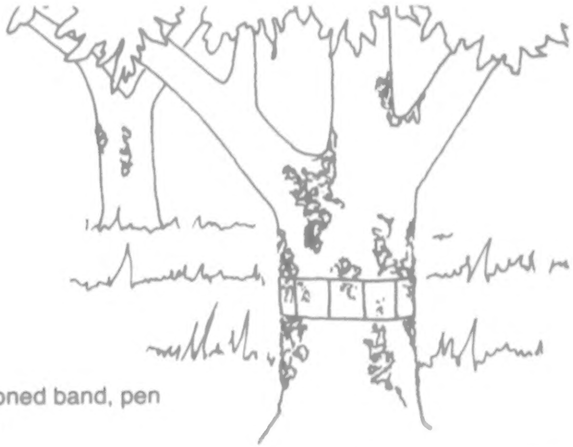
For Plentiful Lichen Populations

HOW MANY LICHENS?
Place the wax-paper band around the trunk of a tree (or around a large rock) so the band end labeled "N" is on the NORTH side of the tree or rock. How many lichens are there in each band section? Use this card to keep score.

10	9	8	7	6	5	4	3	2	1 N

10	9	8	7	6	5	4	3	2	1 N

Try another tree. Are the lichens evenly spaced on the tree or do they grow mainly in certain areas? What might cause this? Do the lichens seem to be clustered on the west, east, north, or south side of the tree?



MATERIALS: sectioned band, pen
Optional: compass

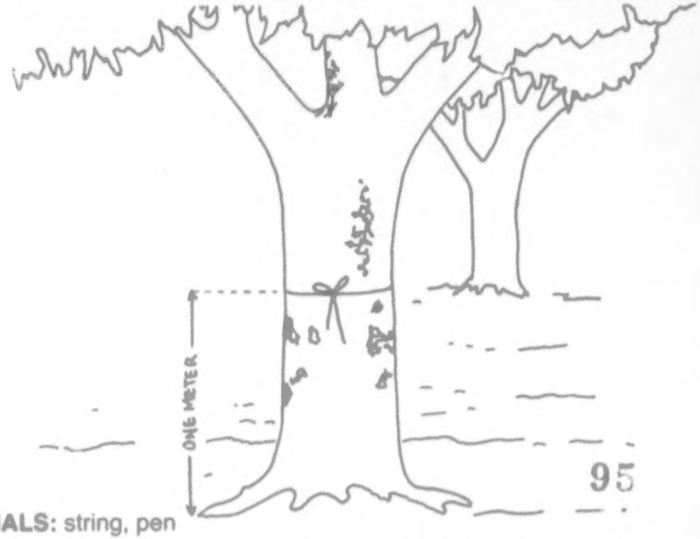
LICHEN LOOKING
Action Card #5b

Outdoor Biology
Instructional Strategies

For Sparse Lichen Populations

HOW MANY LICHENS?
Select several trees (or large rocks) with lichens. Tie the marked string around the trunk of one of them, one meter from the base of the tree. You can use the marked-off string to measure one meter. The one-meter area merely limits your counting area. How many lichens are there below the string? Try this on several other trees (or rocks) and compare results. Use this card to keep score.

Rock or tree	**Rock or tree**	**Rock or tree**



MATERIALS: string, pen

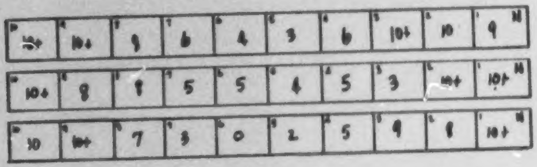
ACTION

1. Explain to the participants that they are going Lichen Looking.
2. Describe the boundaries of the activity site.
3. Point out two or three different kinds of lichens and challenge the youngsters to find all the different places where lichens live in the site. Caution the youngsters to be gentle because lichens develop so slowly that any damage to them would be long lasting. Divide the group into teams of two and send them off.
4. After five minutes, call the teams back to report where they found lichens.
5. For the next challenge, each team selects one tree, rock, or other object for investigation. Allow one minute for tree and rock selection. If territorial battles ensue, assign trees or let two groups work on the same tree. Each team will have 1½ minutes to stick a flag next to each lichen the youngsters can find and reach on their tree or rock. Give each team an envelope of 20 flags. Make masking tape available for attaching pins to rocks. When the teams are ready, give the signal to START. After 1½ minutes, give the signal to STOP. Assemble the group and ask how many lichens each team pinned. Were there any plants on the trees other than lichens? Point out any thick, moist green mounds of moss that might be mistaken for lichens. If you look closely you will discover that moss plants have tiny leafy stalks although they look like green velvet mounds. Do not forget to remove all flags.

6. Now for some serious Lichen Looking! Display five stacks of action cards. (Each stack represents a different action.) Pass out a bag of materials to each team. Each bag contains the materials necessary for all the investigations. Encourage the teams to select action cards and start their investigations.
7. Wander from team to team, offering assistance if needed and allowing the youngsters to share their discoveries with you. When a team is finished with one card, encourage the youngsters to try others.

LOOKING FURTHER

When most teams have finished the investigations, assemble the group. Encourage the teams to share their discoveries. One way to initiate discussion is to ask the teams to compare their results of Action Card 5a. Arrange the sectional bands in a column and ask the group to look for patterns. Do lichens seem to grow on certain sides of trees and rocks? Why might this be?



10+	10+	9	6	4	3	6	10+	10	9
10+	8	8	5	5	4	5	3	10+	10+
10	10+	7	3	0	2	5	9	8	10+

LICHEN LOOKING REVISITED

1. Find a lichen that is dry and brittle. Add water to it and see what happens in a few hours, in a few days. Is there any change?
2. Be on the lookout for lichens wherever you go. Where do they grow?
3. Some Air Quality Control Councils use lichens as indicators of air pollution. Check with your local Environmental Council and see if it has such a program. Perhaps your group could assist in the survey.

WHAT TO DO NEXT

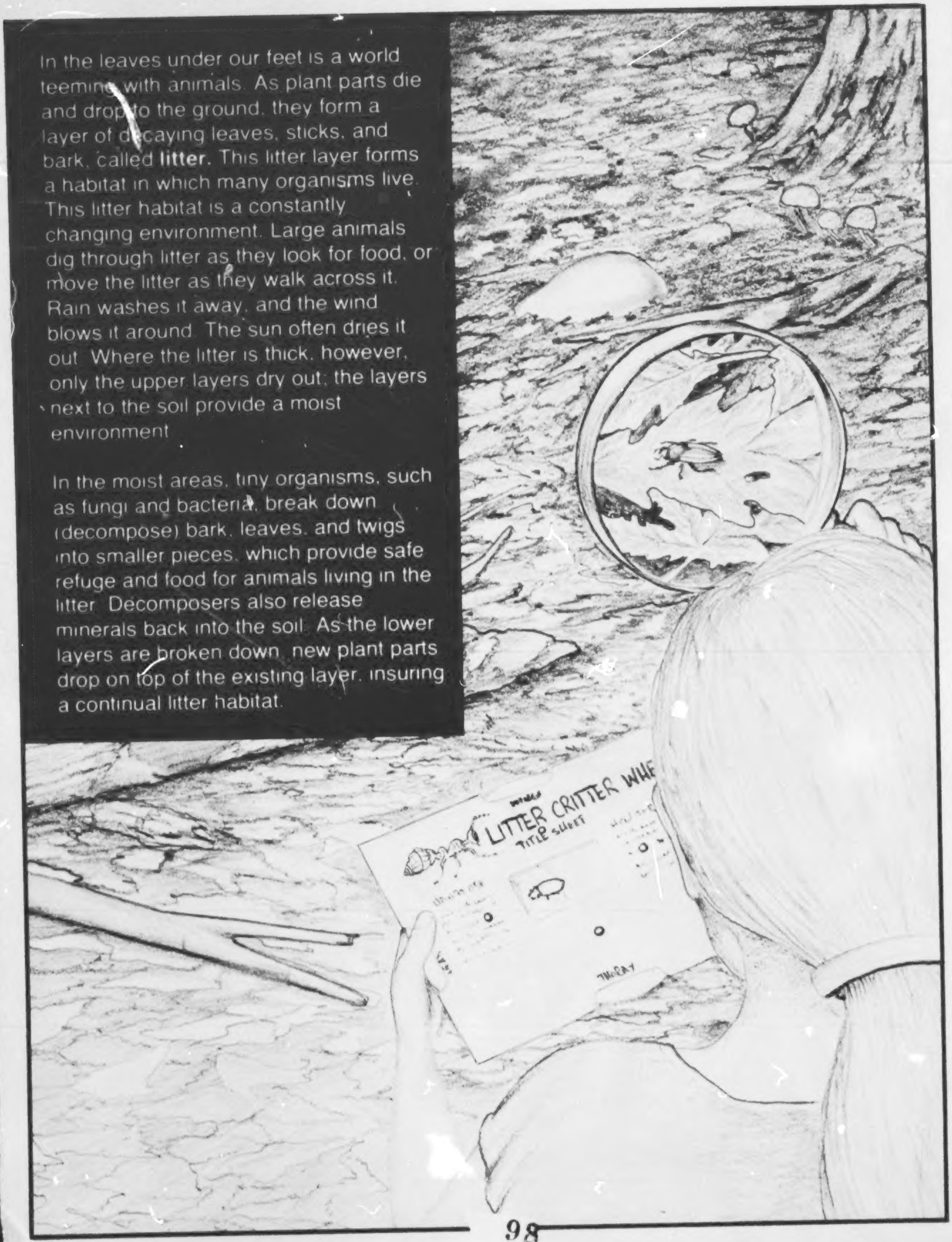
	Set
Plant Patterns	*II*
Animal Diversity	*II*
Invent a Plant	*I*
Invent an Animal	*I*

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

In the leaves under our feet is a world teeming with animals. As plant parts die and drop to the ground, they form a layer of decaying leaves, sticks, and bark, called **litter.** This litter layer forms a habitat in which many organisms live. This litter habitat is a constantly changing environment. Large animals dig through litter as they look for food, or move the litter as they walk across it. Rain washes it away, and the wind blows it around. The sun often dries it out. Where the litter is thick, however, only the upper layers dry out; the layers next to the soil provide a moist environment.

In the moist areas, tiny organisms, such as fungi and bacteria, break down (decompose) bark, leaves, and twigs into smaller pieces, which provide safe refuge and food for animals living in the litter. Decomposers also release minerals back into the soil. As the lower layers are broken down, new plant parts drop on top of the existing layer, insuring a continual litter habitat.



Animals that live in litter are generally small, such as insects, slugs, spiders and salamanders. Small size allows these animals to crawl into tiny crevices between decomposing plant and animal matter. The small size also makes these animals easy to overlook.

DISCOVER THE DIFFERENT KINDS OF ORGANISMS THAT LIVE IN A NATURAL LITTER HABITAT

MATERIALS

For each team of two:

To find and describe litter animals

2 plastic cups
1 bug box or magnifying lens
1 3" x 5" card (to scoop up animals)
1 Litter Critter Wheel
1 sack or bike bag (to hold team materials)

To record animals.

Method 1 (Tracing)

1 pencil
- crayons
2 Record Cards (Reproduce on onionskin paper with a ditto machine)

Method 2

1 pencil
- crayons
1 Litter-Critter Body-Parts Sheet
- transparent tape
- scissors

For the group:

- several white-bottomed containers, dishpans, or milk-carton halves (cut lengthwise)
- several milk-carton Litter Shakers (See the equipment card in the *OBIS Toolbox* folio.)
- extra Record Cards and Body-Parts sheets

Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

See the inserts in this folio.

Outdoor Biology
Instructional Strategies

Equipment Card
LITTER CRITTER WHEEL

With this device, youngsters become familiar with body parts of animals in the litter and develop observational skills. It takes about thirty minutes to assemble one wheel after all the materials are duplicated and gathered. Once assembled, the wheels can be used repeatedly.

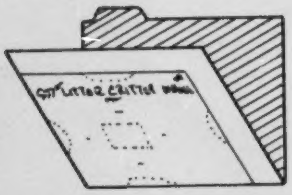
MATERIALS FOR ONE WHEEL:

1 8½″ x 11″ manila file folder
1 duplicated "Litter Critter Wheel Title Sheet" (xeroxed or dittoed)
1 set of 4 wheels (4 overhead transparencies: head, thorax, abdomen, wings)*
4 round-head paper fasteners
1 pair of scissors or single-edged razor blade
• rubber cement or glue

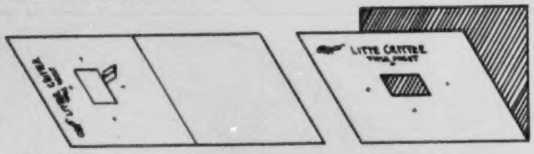
*You can make these transparencies from the masters provided or order them from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

To Prepare the Wheel Folder:

1. Glue the Title Sheet to the file folder, lining up the bottom of the sheet with the folder as shown.

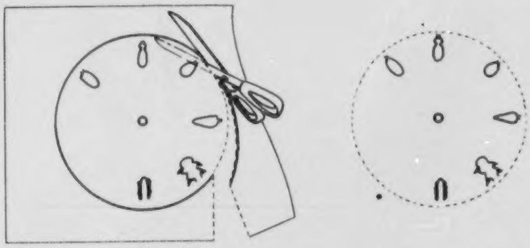


Reduce the folder to the size of the Title Sheet by cutting around the edge of the sheet. The Title Sheet accurately positions the window and also the paper fasteners for the wheel centers.
2. Open the folder and lay it flat with the Title Sheet facing up. With a single-edged razor blade, cut out the window in the Title Sheet, also cutting through the side of the folder on which the sheet is glued.

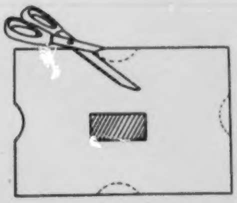


Make a tiny slit at each paper-fastener location through the Title Sheet and the one side of the folder. The slit allows you to push the paper fastener through the sheet more easily.

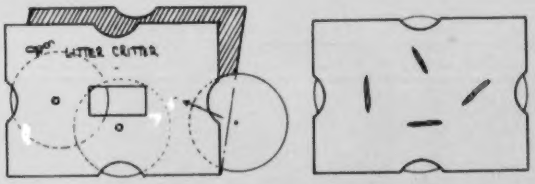
3. Cut out the transparent body wheels *inside* the black outline so that edge of the wheel is clear.



In the center of each wheel, cut a hole the width of the paper fastener so that the wheel will turn freely on the fastener, being careful not to make the hole too big.
4. Cut out the crescent-shaped pieces at the top, bottom, and two sides of the Title Sheet and file folder. These cuts should be made through *both* sides of the folder so the wheels can be turned easily.



5. Use the Title Sheet to guide you in positioning each wheel; put the thorax wheel in first and the wing wheel in last. Place each wheel in the folder and lock it in place with a paper fastener through the center. The paper fasteners should go through both sides of the folder.



6. Your wheel folder is now complete. Each body-parts wheel should turn freely on its fastener and the body parts should line up in the window so you can recreate animals of different shapes.

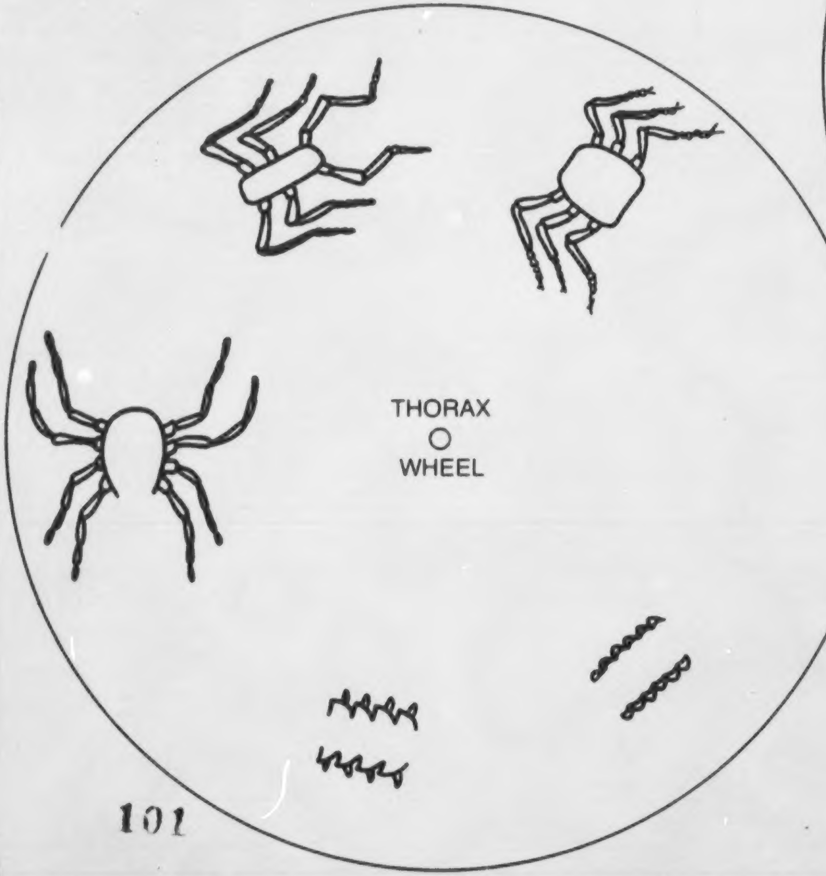
To Use Your Wheel:

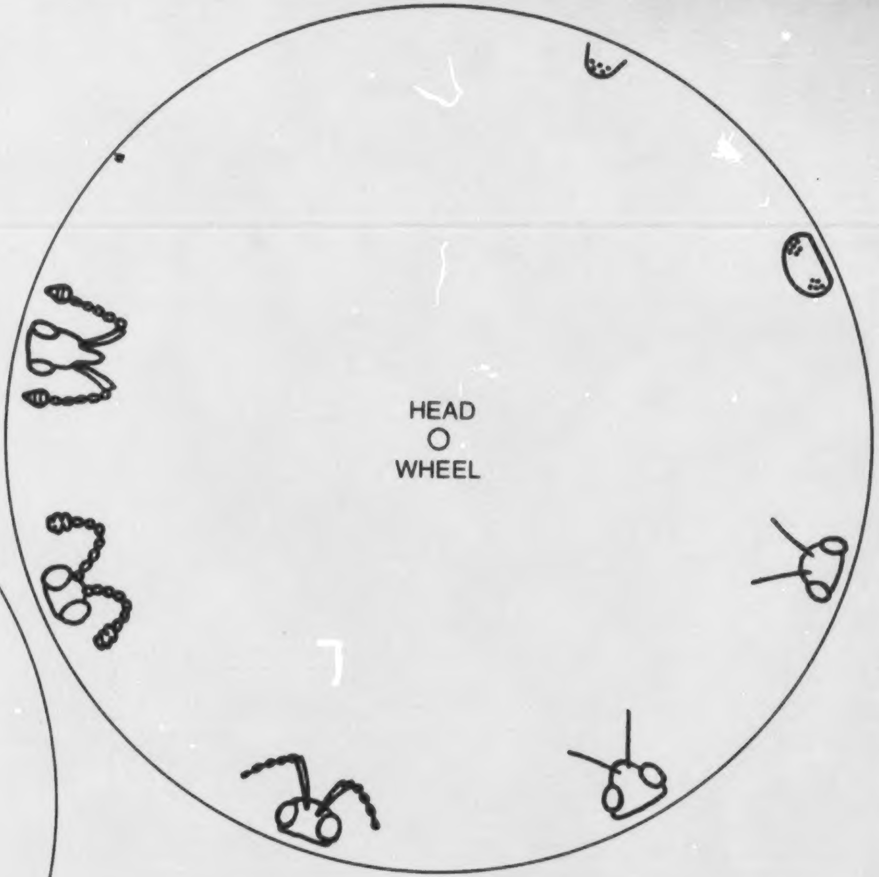
1. Find an animal and look at it closely.
2. Try to recreate your animal by turning each wheel until the best generalized body part appears in the window. You probably will not be able to find the exact body part, so choose the part that most closely resembles your animal's body part.
Note: If, in your area, you consistently find animals whose body parts cannot be found on these wheels, draw in additional body parts on the open spaces on each wheel. The best method for permanently including your own drawings is to draw them on the master wheel or a xerox of the wheel with pencil or black ink. Then make a new transparent wheel to put inside the folder.
3. You can record your animal by either tracing it on a Record Card, or by cutting out appropriate body parts from the Litter-Critter Body-Parts Sheet and taping them to a Record Card. Modify the generalized body parts with pencil and crayons to more accurately represent your animal.

THERMOFAX MASTER, CARD 1 HEAD AND THORAX WHEELS

Litter Critters

Directions: Duplicate these wheels onto an overhead transparency using a thermofax machine or any similar infrared, thermal transparency maker or copy machine. A set of four thermofax transparency wheels is available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.





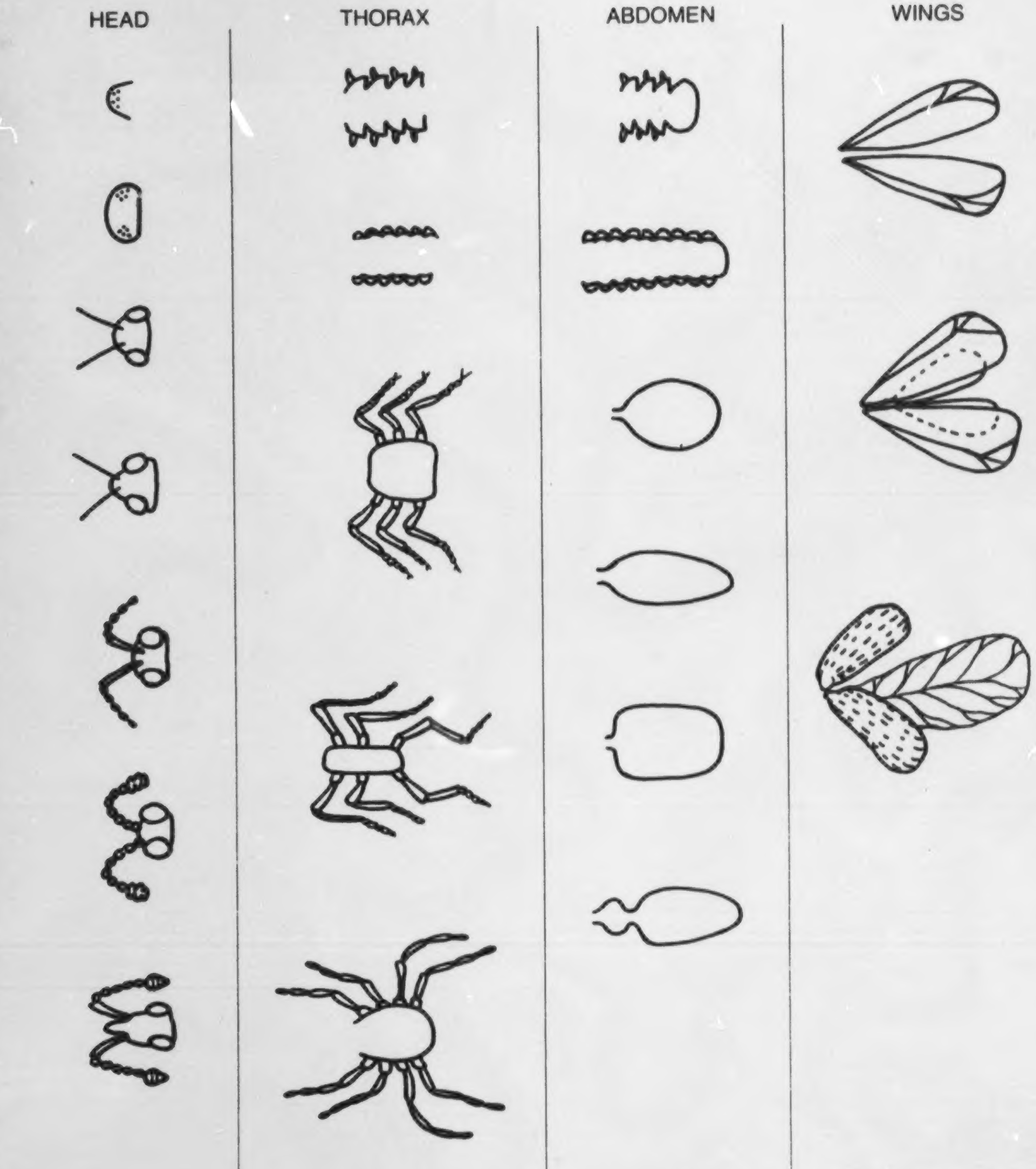
Outdoor Biology
Instructional Strategies

LITTER-CRITTERS
BODY-PARTS SHEET

Outdoor Biology Instructional Strategies

(Use with Recording Method 2.)

Make a record of each litter animal by cutting out the appropriate body part you used to describe the animal on the Litter Critter Wheel. Tape the body parts to your Record Card.



Outdoor Biology
Instructional Strategies

WINGS

LITTER CRITTER WHEELS

TITLE SHEET

HEAD

ABDOMEN

How to use wheel:

1. Turn all four wheels so the window shows no body parts.
2. Locate an animal from the litter.
3. Look at it closely.
4. Select a head (the front part) that most closely resembles the head of your critter by turning the head wheel.
5. Next select a thorax, the middle part of the animal.
   How many legs does it have?
6. Then choose an abdomen, the last part.
7. Finally, does your animal have wings?

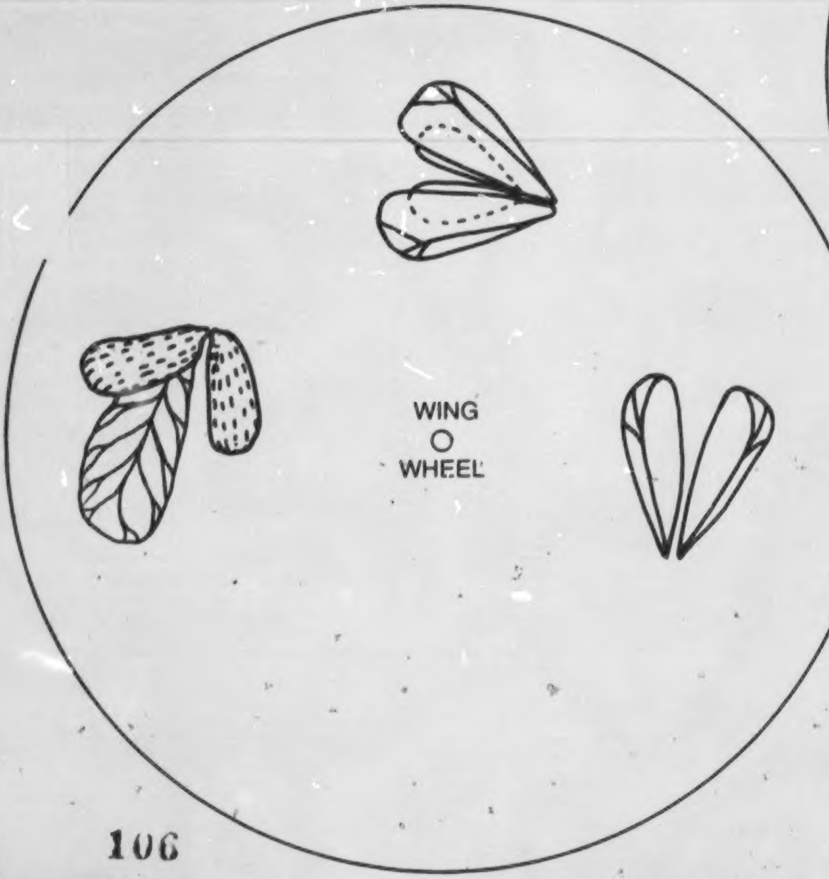
How to make a record of your critter:

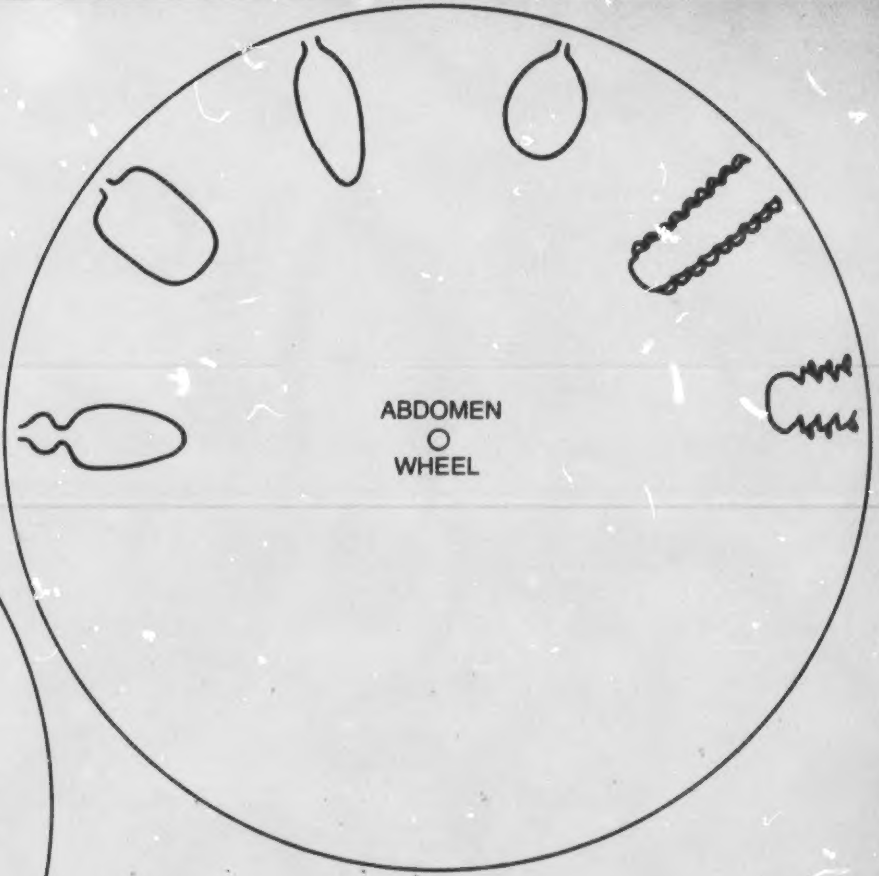
1. Cut out the appropriate body parts from the "Body-Parts Sheet" and tape them to a Record Card.
   Or . . . trace your critter on a Record Card.
2. Color your picture to make it more closely resemble the animal you caught.

THORAX

THERMOFAX MASTER, CARD 2
ABDOMEN AND WING WHEELS

Directions: Duplicate these wheels onto an overhead transparency using a thermofax machine or any similar infrared, thermal transparency maker or copy machine. A set of four thermofax transparency wheels is available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.





Outdoor Biology Instructional Strategies

Litter Critter Wheel RECORD CARD

Outdoor Biology Instructional Strategies

Team ____________ Activity Site ____________

Date ____________

Reconstruct your organism here:

HEAD THORAX ABDOMEN

Size:

(Draw a line as long as the organism.)

- Are there any special color patterns on your organism?
- Draw on any special features you think are important.
  Color your picture to make it more closely resemble the captured organism.

Litter Critter Wheel RECORD CARD

Outdoor Biology Instructional Strategies

Team ____________ Activity Site ____________

Date ____________

Reconstruct your organism here:

HEAD THORAX ABDOMEN

Size:

(Draw a line as long as the organism.)

- Are there any special color patterns on your organism?
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Litter Critter Wheel RECORD CARD

Outdoor Biology Instructional Strategies

Team ____________ Activity Site ____________

Date ____________

Reconstruct your organism here:

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(Draw a line as long as the organism.)

- Are there any special color patterns on your organism?
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Litter Critter Wheel RECORD CARD

Outdoor Biology Instructional Strategies

Team ____________ Activity Site ____________

Date ____________

Reconstruct your organism here:

HEAD THORAX ABDOMEN

Size:

(Draw a line as long as the organism.)

- Are there any special color patterns on your organism?
- Draw on any special features you think are important.
- Color your picture to make it more closely resemble the captured organism.

PREPARATION

Read the "Litter Critter Wheel" equipment card enclosed in this folio. Duplicate the necessary parts so you will have everything you need for the teams to assemble their own wheels. Plan for thirty extra minutes for wheel-assembly time. Once assembled, the wheels can be used repeatedly.

Select a site with litter but also one that is not likely to harbor any organisms that might be dangerous to humans. If you think some children will be reluctant to search through the litter with their hands, assemble some milk-carton litter shakers. (See the "Litter Shaker" equipment card in the *OBIS Toolbox* folio.)

ACTION

1. At the activity site, challenge the kids to locate and record the kinds of animals that live in the litter. Explain that you mean natural litter from plants, not man-made litter. Pick up some litter and show it to the group.
2. Tell the kids that when searching the site for animals, they can use any method of capture as long as it does not injure the animals. The group will be divided into search parties of two and each party will catch one to three different litter animals. Explain to the kids that they should not dig into the soil, but just search the litter layer. If some children seem reluctant to search through the litter with their hands, demonstrate and distribute some litter shakers.

Note: Ask the kids to return any logs, rocks, or layers of litter to their original spots after the search is completed.

3. Show the participants how to dial the generalized body parts on the Litter Critter Wheel to match the parts of their particular animals.
4. Ask the kids to make records of the animals they select on a record card. Records can be made by tracing the outline that appears in the window (Method 1) or by cutting out body parts from the body parts sheet (Method 2). Encourage the kids to use pencils and crayons to make their records more closely resemble their particular animals.
5. Divide the group into search parties and send them on their search. During the hunt, you might wish to circulate and offer assistance. If the majority of the group has difficulty finding animals, dig in and look for some yourself!
6. After all the participants have recorded their animals, ask the teams to bring their animals (in cups or bug boxes) and their record cards to a central point for comparisons.

WHAT DO YOU THINK?

☐ How many kinds of animals did the group find?
☐ Which animals had all three body parts?
☐ Which animals had wings?
☐ Which areas of the litter contained the most animals? How are the animals found in the moist litter different from those in the dry parts?
☐ What were some difficulties you had in recording some organisms?
☐ What generalizations could you make about the color, size, and movements of litter critters?

FOLLOW THROUGH

1. Investigate organisms associated with man-made litter. Compare animals found around cans, bottles, paper, etc., to the animals you found in natural litter.
2. Do the same activity in different litter habitats. How does the number of different kinds of animals (diversity) or the population size of one kind of animal (abundance) compare at the different sites?
3. Do the same activity at the same site at different times of the year: under snow, after rain, during rain. If animals are not present at these times, where do you think they went? If animals are present, how do they compare with those originally found?

WHAT TO DO NEXT

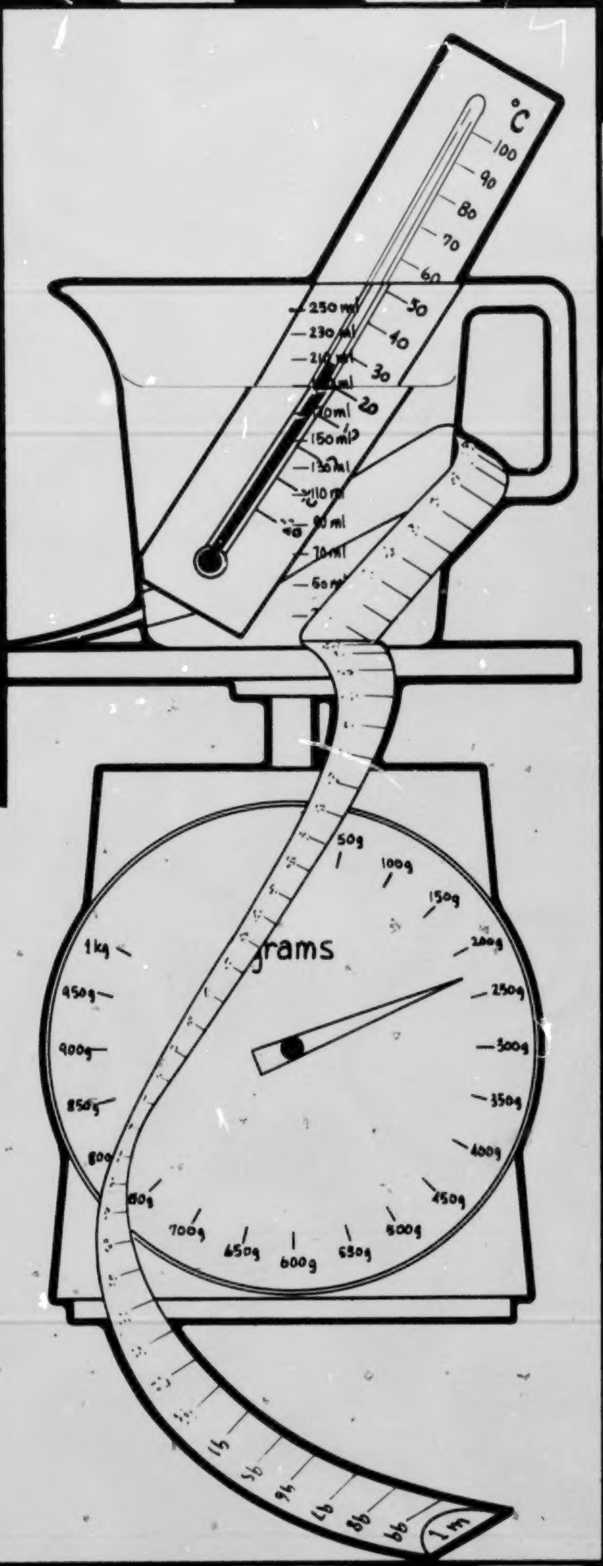
	Set
Animal Diversity	*II*
Old White Sheet Trick	*II*
Animals in a Grassland	*I*
Sticklers	*I*

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

You may have heard the old saying, "Give 'em a centimeter and they'll take a kilometer." Give your youngsters centimeters, kilometers, liters, grams, and degrees celsius, and they will take home a new system of weights and measures. The **metric system** is the household system of measure in most countries outside the U.S. Soon the metric system will be in common use in the U.S. and you will be ready. Measurements in all OBIS activities are conducted in metrics, so you might want to go on a metric caper before embarking on other investigations. The basic metric system is pictured here.

LEARN ABOUT THE METRIC SYSTEM BY MEASURING FAMILIAR OBJECTS IN YOUR ENVIRONMENT.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900g
950g
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98
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1m

WEIGHT
Basic unit is the gram (g)
1000 milligrams (mg) = 1 gram
1000 grams = 1 kilogram (kg)
1000 kilograms = 1 metric ton

LENGTH
Basic unit is the meter (m)
1000 millimeters (mm) = 1 meter
100 centimeters (cm) = 1 meter
1000 meters = 1 kilometer (km)

VOLUME
Basic unit is the liter (l)
1000 milliliters (ml) = 1 liter

TEMPERATURE
Basic unit is the degree Celsius (°C)
0°C = ice
100°C = boiling water

MATERIALS FOR A CAPER

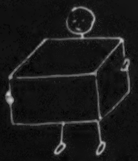
For the group to:

Measure Weight

- 2 scales (0-10 kilogram), fisherman's scales are fine
- 2 scales (0-2,000 gram)
- 4 strong plastic or paper bags
- • twine to tie bags shut

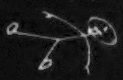
Measure Length

- 1 meter tape for every two kids
- 4 flag sticks (any stick about 1 meter long)



Measure Volume

- 1 liter container for every two kids
- 1 250-ml measuring cup for every two kids
- 1 bucket or bottle of water
- 1 10-liter bucket (optional)



Measure Temperature

- 1 celsius thermometer for every two kids
- 1 thermos of hot water
- 2 styrofoam cups

Odds 'n' Ends

- 15 strips of bright cloth (see PREPARATION section)
- • pencils
- • practice sheets and caper cards (see PREPARATION section)

Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

See the "Measuring Length" and "Measuring Volume" equipment cards in the *OBIS Toolbox* folio.

BEFORE THE CAPER

You will need to gather measuring tools and paper. Because you will probably not want to investigate all four types of measurement in one day, select two measurements to investigate. Gather the materials needed for the two measurements you select.

Flagging. Make flagging by cutting bright cloth or plastic into 4 cm x 30 cm strips. The kids will use the flags to mark the objects they measure: rocks, branches, leaves, etc. Attach four of the flags to sticks and place two flags on two opposite ends of the activity site.

Practice Sheets and Caper Cards. Make practice sheets and caper cards like the ones that appear in this folio. Each type of card should contain measuring exercises from both types of measurement you have selected. You will need one practice sheet for each participant and at least four caper cards for the group.

METRIC CAPERS

PRACTICE SHEET FOR LENGTH AND WEIGHT

my metric shoe length is cm
my eyes are cm apart
my metric hat size is cm
my coat weighs kg
my belt is cm long
my neck is cm around
my purse weighs grams
my shoe weighs grams
mystery number (sum)

PRACTICE SHEET FOR TEMPERATURE AND VOLUME

the volume of my shoe is ml
(fill with sand measure that volume)
the temperature of the air is C
the volume of my fist is ml
the temperature of the soil is C
the volume of water I can hold in my hand is ml
the temperature of some mud is C
my body temperature is C
mystery number (sum) is

CAPER CARD FOR TEMPERATURE AND VOLUME

temperature of some warm water C
temperature of soil 5-cm deep C
volume of a rock ml
volume of a bag of soil ml
temperature of a rock C
volume of a batch of sticks ml
mystery number (sum)

CAPER CARD FOR LENGTH AND WEIGHT

length between two flags m
length of one branch cm
length of one leaf cm
weight of one rock g
weight of a bag of soil g
weight of one bag of rocks kg
mystery number (sum)

ACTION

1. Becoming familiar with the metric system. Tell the kids you have brought a box of measuring tools. Show the kids how to use the tools to make metric measurements.

Length: meter tape (Measure directly.)
Temperature: celsius thermometer (Read directly.)
Weight: gram and kilogram scales (Read directly.)
Volume: liter container and 250-ml cup (See "Measuring Volume" equipment card for use.)

2. After you have selected the measurements you plan to explore, distribute practice sheets and the appropriate tools to the kids. Allow the kids ten to fifteen minutes to fill out the practice sheets.

3. **Metric Caper.** Divide your group into two teams. Distribute at least two caper cards to each team (identical caper cards for both teams) and direct the teams to opposite sides of your activity area with these instructions:

a. Using the tools, work as a team to fill in the blanks on one card.
b. Use the colored flagging to clearly mark each item measured: branches, rocks, cups of water, leaves, bags of soil, etc.
c. When all measurements are recorded on the card, add up the numbers to obtain the secret mystery numbers.

4. Ask each team to keep one caper card unmarked for recording their estimates of the other team's measurements and calculating the team's mystery number. Go!

5. **Guestimating Mystery Numbers.** When both teams have completed their measurements, call them together.

Explain that each team is going into the other team's territory to estimate, without using measuring tools, the values for the items the other team measured. Have each team try to determine the opposition's mystery number. You might wish to subdivide the teams into buddy teams to encourage everyone to make guestimates. Which team comes closest?

AFTER THE CAPER

☐ Hold up several cans and bottles from the supermarket and have the kids estimate the volume and/or weight of the contents. Open a can of peas and find the weight of the peas and the weight of the liquid.

☐ Make a metric collage. In your activity area, find objects that are exactly 1 gram, 1 kilogram, 1 liter in volume, 1 meter, etc.

☐ How fast can you run? Use a watch to find out how many meters you can run in one minute.

☐ How fast do bugs walk? How fast do butterflies fly?

WHAT TO DO NEXT

	Set
Beach Zonation	II
Bean Bugs	I
Terrestrial Hi-Lo Hunt	I

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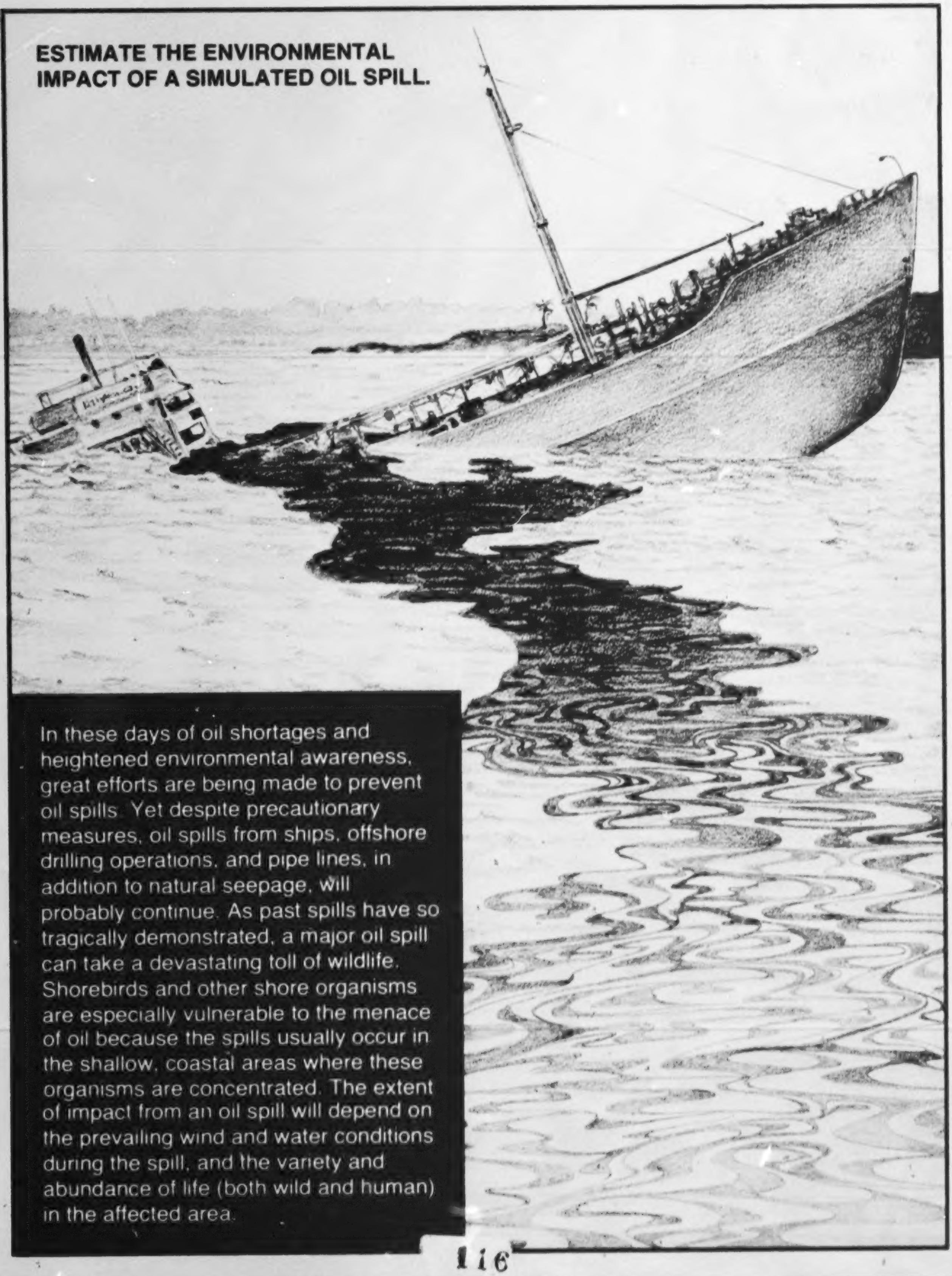
ESTIMATE THE ENVIRONMENTAL IMPACT OF A SIMULATED OIL SPILL.



In these days of oil shortages and heightened environmental awareness, great efforts are being made to prevent oil spills. Yet despite precautionary measures, oil spills from ships, offshore drilling operations, and pipe lines, in addition to natural seepage, will probably continue. As past spills have so tragically demonstrated, a major oil spill can take a devastating toll of wildlife. Shorebirds and other shore organisms are especially vulnerable to the menace of oil because the spills usually occur in the shallow, coastal areas where these organisms are concentrated. The extent of impact from an oil spill will depend on the prevailing wind and water conditions during the spill, and the variety and abundance of life (both wild and human) in the affected area.

SIMULATING A SPILL

You might want to do *What Lives Here?* (I) or *Flocking to Food* (II) to introduce the youngsters to the organisms in your site before you tackle this activity.

In this activity, youngsters create a simulated oil spill with popcorn and estimate the environmental impact of the artificial disaster. (You can substitute dry leaves, sawdust, or wood shavings for the popcorn.) The kids pretend to be environmental experts who have been rushed to the scene of an "oil spill" to estimate its impact.

The group is divided into buddy teams (pairs) and one or two buddy teams are assigned to each of the following impact areas: landscape, plant life, animal life, and human activities. The teams work on the assumption that anything the popcorn touches will be covered with oil.

MATERIALS

1 "Popcorn Slinger" (see equipment card in the *OBIS Toolbox* folio)
20 liters of popped corn (another 20 liters will be needed for the FOLLOW THROUGH; see PREPARATION for source)

PREPARATION

Site. Although this activity was developed at the seashore, you can also conduct the activity at a lake, river, or stream. Reduce the amount of popcorn for smaller bodies of water. The activity will be more exciting if you choose a site with strong dispersal features (water currents, wind, etc.) and an abundance of life. Breakwaters or docks are convenient places from which to toss popcorn into the water. For inland waters where oil spills rarely occur, you can simulate a toxic chemical discharge from an industrial or agricultural source.

Safety. The buddy system is a good safety precaution. OBIS does not suggest going into the water, but cold water, large waves, strong currents, and slippery rocks dictate that safety be a prime consideration. Find out who the nonswimmers are and keep a particularly close eye on them.

Popcorn. You can usually obtain stale, popped corn free of charge or for a nominal fee from popcorn concessionaires. Look under "Popcorn" in the Yellow Pages. If you cannot obtain stale popcorn, pop a two-pound bag of corn, which makes about 24 liters.

OBIS OIL SPILL
Impact Challenge Card #1

Outdoor Biology
Instructional Strategies

Landscape. Follow the spill and estimate its impact on the landscape. Use a 25-meter length of twine to measure the area the spill covered.

Estimates: Water____sq. meters (length times width)
Land____sq. meters (length times width)

Where did most of the popcorn end up? Why? How might the underwater landscape be affected? How did the spill change the general appearance of the landscape?

OBIS OIL SPILL
Impact Challenge Card #2

Outdoor Biology
Instructional Strategies

Plant Life. Follow the spill and estimate its impact on plant life.
How many different types of plants were affected?
Which plants were hardest hit by the spill? Why?
How might an oil spill affect land plants?
How would animals that eat aquatic plants be affected?

OBIS OIL SPILL
Impact Challenge Card #3

Outdoor Biology
Instructional Strategies

Animal Life. Follow the spill and estimate the impact of the spill on the animal life.
How many different types of animals were covered with oil?
Which animals were hardest hit by the spill? Why?
Which animals do you think would be capable of escaping from a spill? Which animals might not be able to escape?
How might an oil spill affect animals that live under rocks in the water?

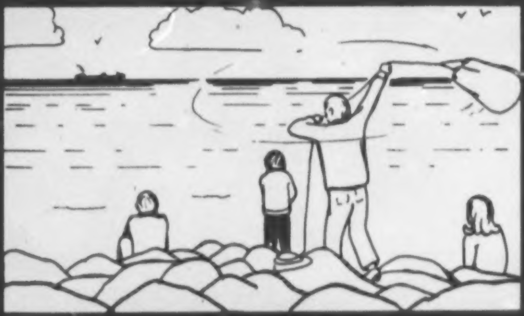
OBIS OIL SPILL
Impact Challenge Card #4

Outdoor Biology
Instructional Strategies

Human Activities. Follow the spill and estimate its impact on human activities.
How might an oil spill affect fishing and other recreation activities such as swimming, water skiing, surfing, diving, etc?
How might boats, docks, breakwaters, and other water structures be affected?
How might drinking water or food be affected by an oil spill?

ACTION

1. At the activity site, quickly outline the activity. Explain to your group of environmental-impact experts that they are responsible for estimating the impact of the spill on (a) the landscape, (b) the plant life, (c) the animal life, and (d) human activities. Divide the group into buddy teams and assign one to two teams to each of the above areas by handing out Impact Challenge Cards. Remind the teams to work on the assumption that anything the popcorn touches will be covered with oil.
2. Before you toss out the popcorn, ask the teams to predict in which direction the spill will move and how long it will take to reach the shore. Select a buddy team with a wristwatch to measure the time it takes for the spill to reach the shore or other reference point.
3. Toss out the popcorn and let your environmental experts begin their impact investigations.



4. Join in and follow the movement of the spill with the rest of the group.

SLICK TALK

Near the end of the alloted time or after the spill has been thoroughly dispersed, gather the teams together to report their impact findings on (a) the landscape, (b) the plant life, (c) the animal life, and (d) human activities.

Some impact questions to consider:

How quickly did the spill reach the shore?

What agents dispersed the spill? (Wind, tide, etc.)

How might different wind or water conditions affect the spill?

How could an oil spill be prevented from spreading?

Who should be responsible for cleaning up the spill?

FOLLOW THROUGH

Try creating another "oil spill" under different conditions (outgoing versus incoming tide, windy versus calm day) or in a different site (river versus lake, ocean versus lake, one side of a breakwater versus the other side, etc.). Compare the effects of the second spill with those of the first.

Try different methods of containing an oil spill.

FURTHER INVESTIGATIONS

	Set
Water Breathers	*II*
Trail Impact Module	*Module*
Too Many Mosquitoes	*II*
Great Streamboat Race	*I*

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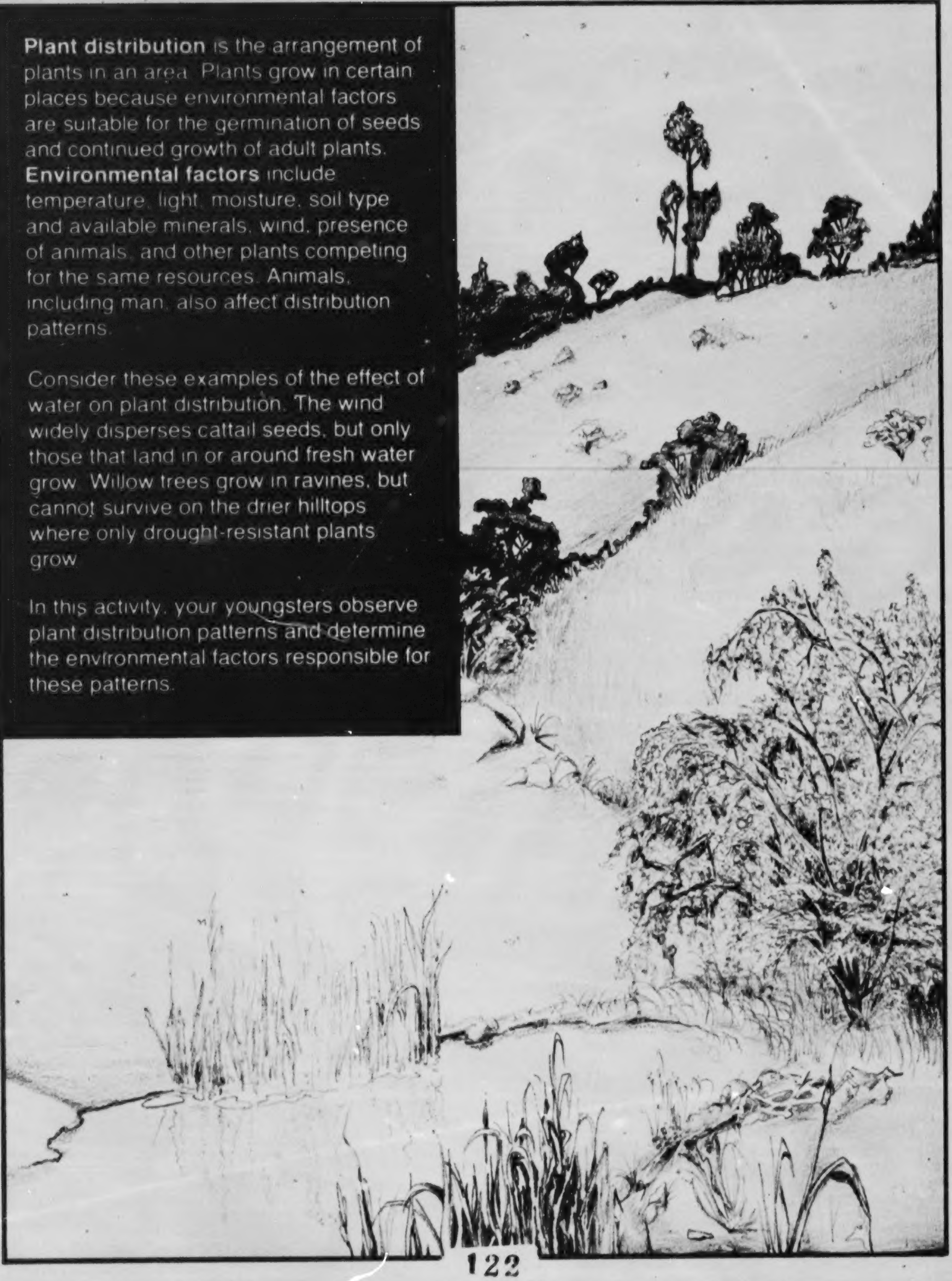
Plant distribution is the arrangement of plants in an area. Plants grow in certain places because environmental factors are suitable for the germination of seeds and continued growth of adult plants. **Environmental factors** include temperature, light, moisture, soil type and available minerals, wind, presence of animals, and other plants competing for the same resources. Animals, including man, also affect distribution patterns.

Consider these examples of the effect of water on plant distribution. The wind widely disperses cattail seeds, but only those that land in or around fresh water grow. Willow trees grow in ravines, but cannot survive on the drier hilltops where only drought-resistant plants grow.

In this activity, your youngsters observe plant distribution patterns and determine the environmental factors responsible for these patterns.



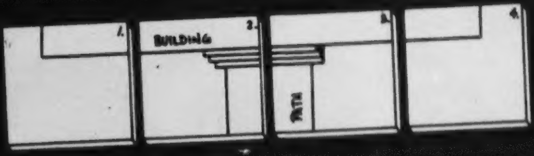
LOCATE AND MAP THE EIGHT MOST IMPORTANT PLANTS IN YOUR TEAM'S SECTION OF THE STUDY SITE.

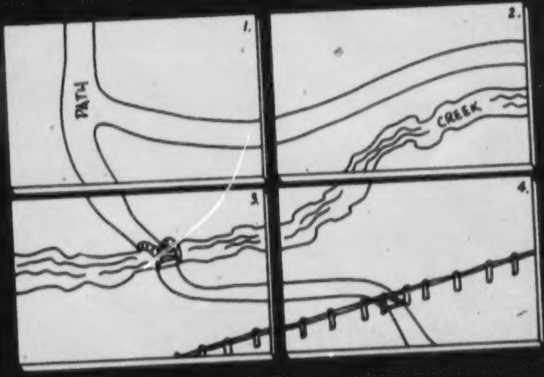
PREPARATION

In choosing your study site, keep in mind that an unmanaged area (vacant lot or field) shows the influence of natural environmental factors on plant distribution. A managed area (garden or park), however, illustrates man's influence. The best study site is one containing both types of areas where teams could compare different plant patterns.

Each team of two to four should work in an area 8-10 meters square. To avoid confusion, mark the corners of each of the sections in the study area with ribbon or flagging.

You can prepare the basic overview map ahead of time or with the group. Draw an overview map of the physical structures of the entire study site including streams, roads, sidewalks, and buildings. Do not include plants. If there are four teams, the map should cover four data boards. With large groups, divide the area into more sections rather than putting more members on each team.





MATERIALS

For each team of two to four:

1 data-board map section
1 felt pen
2-4 paper collection cups or bags
● bag containing 8 different colors of self-adhesive labels, 40 labels of each color (or squares or dots of contact paper, crayons, or colored construction paper and glue). A good size range for the labels is 1.5 to 3 cm.

For the group:

● ribbon or flagging
1 data board
1 roll of transparent tape

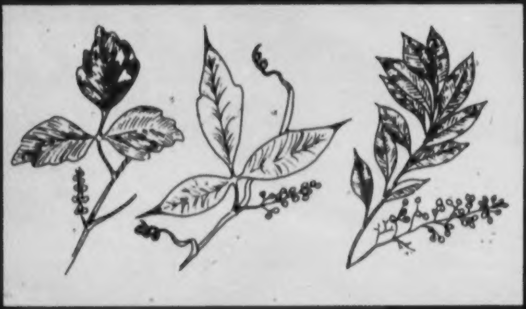
See the *OBIS Toolbox* folio for instructions on making a data board.

ACTION

2

1. Construction of the leaf identification key.

a. Set the limits of the study site. Review the conservation ethic with regard to taking leaf samples. (See the *Leader's Survival Kit* folio.) If necessary, obtain permission to take leaf samples from the site. If you cannot collect a leaf sample from a particular plant, a sketch of the leaf is a good substitute. (Avoid poison oak, ivy, or sumac, and point them out to the group ahead of time.)

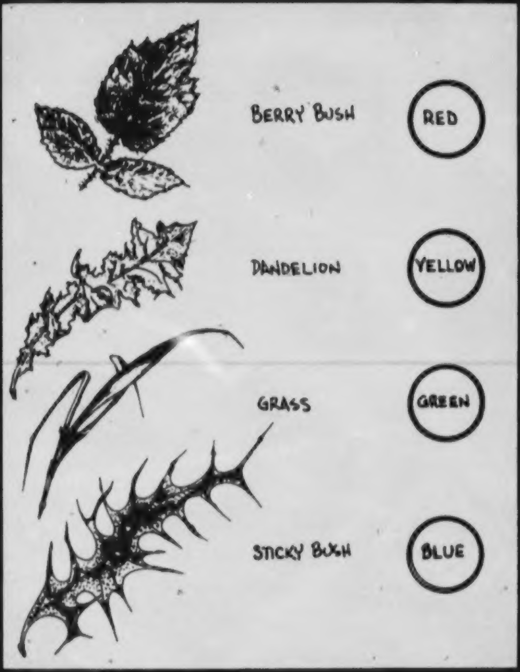


poison oak poison ivy poison sumac

b. Have each youngster collect a leaf or representative sample from the five most important plants in the entire area. Let each child decide which plants are "important." You may wish to offer a few suggestions as to what makes a plant important: its size, its economic significance, its beauty, its aroma, etc.

c. Have the youngsters place leaves of the same type in one container. You might ask the participants how they decided which plants were important. The eight plants selected most often by the group will be named the most important plants. Construct a leaf identification key by taping these plant samples to the group data board.

Represent each type of plant with a label of a different color and or shape. Allow the students to choose the labels for the plants and place them on the data board.



Example of leaf identification key

2. Display the overview map of the study site and orient the group.

3. Separate the map into its original sections and divide the group into teams of two to four.

4. Introduce the challenge: Using the colored labels which represent different plants, LOCATE AND MAP THE LOCATION OF THESE PLANTS IN YOUR SECTION OF THE STUDY SITE.

5. Describe the action:

a. Each team duplicates the leaf identification key, using leaf samples, on its own section of the map.

b. The teams take their data boards and labels and survey their study areas. Each time someone finds one of the eight plants, he or she should place the corresponding colored label at the appropriate location on the map.

6. When everyone is finished surveying and mapping, put the sections of the map together and gather for a group discussion. Each team should briefly describe the plant patterns revealed on its section of the map.

WHAT DO YOU THINK?

1. What is the most common color on the overview map and which plant does it represent? The most abundant plants in an area are called **dominants.** Dominant plants cover more space or are larger than others and usually have a controlling influence on other organisms in the area. What are the dominant plants in your study area?
2. Do certain colors appear next to each other several times on the map? Why might this be?
3. Introduce the meaning of **plant distribution:** the arrangement of plants in an area. Which **environmental factors** (light, wind, rain, soil) might be affecting the distribution of the plants we found?
4. Animals, including man, are also considered environmental factors. What effect do animals and man have on the distribution of plants in your area?

FOLLOW THROUGH

Use your map to indicate where animal activity occurs in the study area by marking trails, feces deposits, fur or feather snags, etc., on the map.

WHAT TO DO NEXT

	Set
Lichen Looking	*II*
Sensory Hi-Lo Hunt	*II*
Terrestrial Hi-Lo Hunt	*I*
Plants Around a Building	*I*

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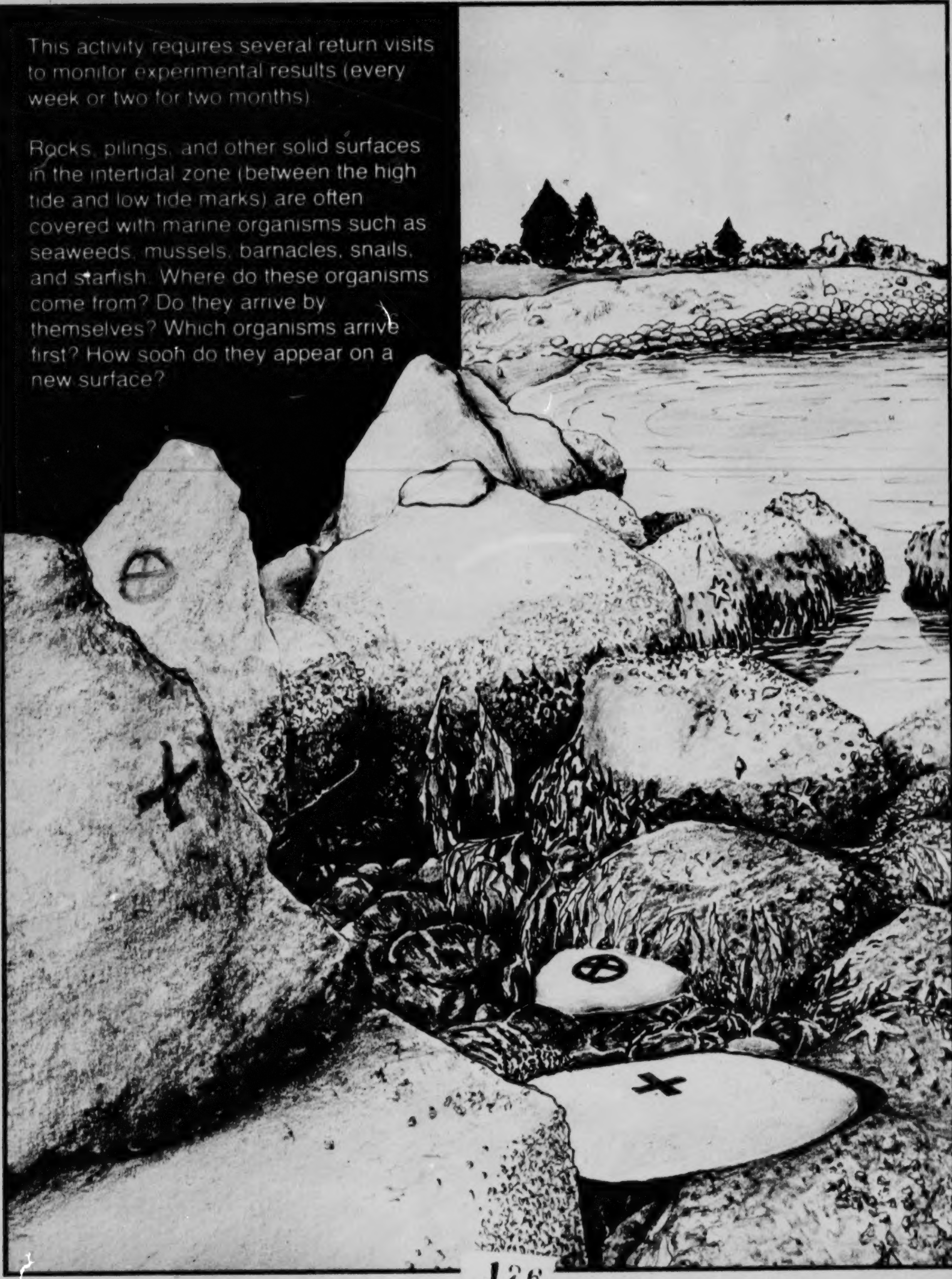
This activity requires several return visits to monitor experimental results (every week or two for two months).

Rocks, pilings, and other solid surfaces in the intertidal zone (between the high tide and low tide marks) are often covered with marine organisms such as seaweeds, mussels, barnacles, snails, and starfish. Where do these organisms come from? Do they arrive by themselves? Which organisms arrive first? How soon do they appear on a new surface?



PLACE A BARE ROCK IN THE INTERTIDAL ZONE AND WATCH TO SEE WHICH ORGANISMS COLONIZE IT AND WHEN THEY ARRIVE.

This activity investigates the process of **colonization**: the establishment of a population of organisms in an area where that organism did not appear before. You can observe this process by introducing new surfaces (Pioneer Rocks) into the intertidal zone, and monitoring the developments on these surfaces. If you observe your Pioneer Rocks for a long enough period of time, you may see some of the pioneer organisms replaced by other populations. **Succession** is the replacement of one population with another. This process will continue until the plants and animals on your Pioneer Rocks look just like those on the surrounding rocks.

MATERIALS

For each team of two:

1 marking pen (permanent ink, bright colors)

For the group:

1 data board
1 marking pen

PREPARATION

Choose a site with rocks that are accessible to the kids. You should be aware of the tidal situations for your planned activity times. If you happened to meet during a high tide, your experiments would be covered by water and out of reach. You can obtain a tide table from bait shops and sporting goods stores. (See "Use of the Tide Table" Equipment Card in the *OBIS Toolbox* folio.) The first activity will take one period, but follow-up observations may take only ten to fifteen minutes. Plan other activities for those days. (See SUBSEQUENT MEETINGS section.)

Caution! Rocks in the intertidal zone are notoriously slippery. Caution your youngsters to use care moving over them and in placing the new rocks in the intertidal zone; fingers and toes caught between rocks can ruin the activity. Use the buddy system; no one should work alone during a seaside activity.

CAUTION!
SLIPPERY!

ACTION

1 **The Intertidal Zone.** Caution the youngsters about the slippery rocks and then take the group into the intertidal zone. Explain that this zone is the area between the high and low tide marks.

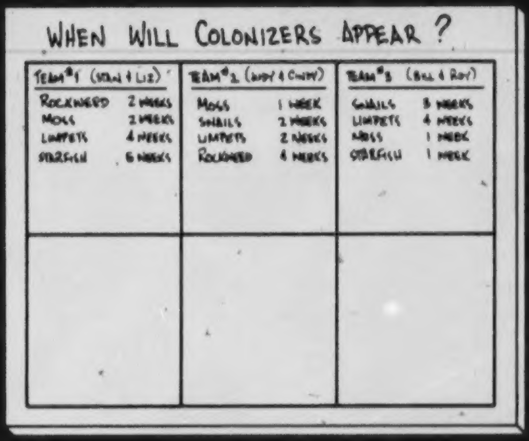
2 **Observing Life on the Rocks.** Point out a rock that seems to be a popular place for a number of different plants and animals to live. Ask the participants how they think the organisms got there. Allow time for your group to observe and comment. Does someone plant the organisms? Do they arrive by themselves? How can we find out? If the kids don't suggest putting something into the water to check colonization, suggest it yourself.

3 **Introducing New Real Estate.** Divide the group into buddy teams and ask each team to select a rock or other substrate to place in the intertidal zone. (See the VARIATIONS section.) Large rocks are best. However, if anyone is struggling with a rock that is obviously too large, step in and suggest something more reasonable. Be sure there is *no life* on these rocks. Distribute the marking pens and urge each team to mark its rock and a place on the shore near it so the rock can be found later. The "permanent" marks last only two to three weeks in the ocean environment, so you may have to re-mark your rocks.

4 **Introducing Colonization.** Define colonization and suggest that each rock being introduced into the study area is an unpopulated territory and the organisms that settle there are colonists. Names for the rocks (Pioneer Rock, Wanderer's Roost) are fun and should be encouraged.

RETURN VISITS

Now the real fun begins: finding out what happens! It may take several weeks for visible colonists to appear on your rocks. (Do the rocks feel or smell different before you see any changes?) When visible colonists do arrive, you should record their names and the date they were first observed. If you don't know the names of the organisms, make up some descriptive names (thread weed, polka dot snails).



WHEN WILL COLONIZERS APPEAR ?

TEAM #1 (STAN & LIZ)		TEAM #2 (ANDY & CINDY)		TEAM #3 (BILL & ROY)	
ROCKWEED	2 WEEKS	MOSS	1 WEEK	SNAILS	3 WEEKS
MOSS	2 WEEKS	SNAILS	2 WEEKS	LIMPETS	4 WEEKS
LIMPETS	4 WEEKS	LIMPETS	2 WEEKS	MOSS	1 WEEK
STARFISH	6 WEEKS	ROCKWEED	4 WEEKS	STARFISH	1 WEEK

THINKING ABOUT YOUR PIONEERS

Are rocks that are placed at different levels in the intertidal zone colonized at different rates?

Did the same organisms colonize all of the Pioneer Rocks?

Did the amount of exposure to air influence either the numbers or kinds of organisms colonizing your rocks?

Are the organisms on your Pioneer Rocks the same as those on the surrounding rocks? Are there any differences?

VARIATIONS

To add some variety to this activity, you may wish to substitute wood, steel, plastic, or rubber for rocks. These substrates usually find their way into the sea through natural processes or man's neglect. You can find most of these substrates at or near your study site. Small and/or lightweight objects may have to be tied and anchored with twine to prevent tides from carrying them off.

FURTHER INVESTIGATIONS

1. Can you find substrates other than your pioneer rocks displaying various stages of colonization and succession?
2. How does man combat colonization of organisms on boats?
3. Where do you *not* find organisms colonizing a substrate? Can you figure out why?

SUBSEQUENT MEETINGS

	Set
Beach Zonation	*II*
OBIS Oil Spill	*II*
Hopper Circus	*II*

WHAT TO DO NEXT

	Set
Water Holes to Mini-Ponds	*I*
Out of Control	*I*

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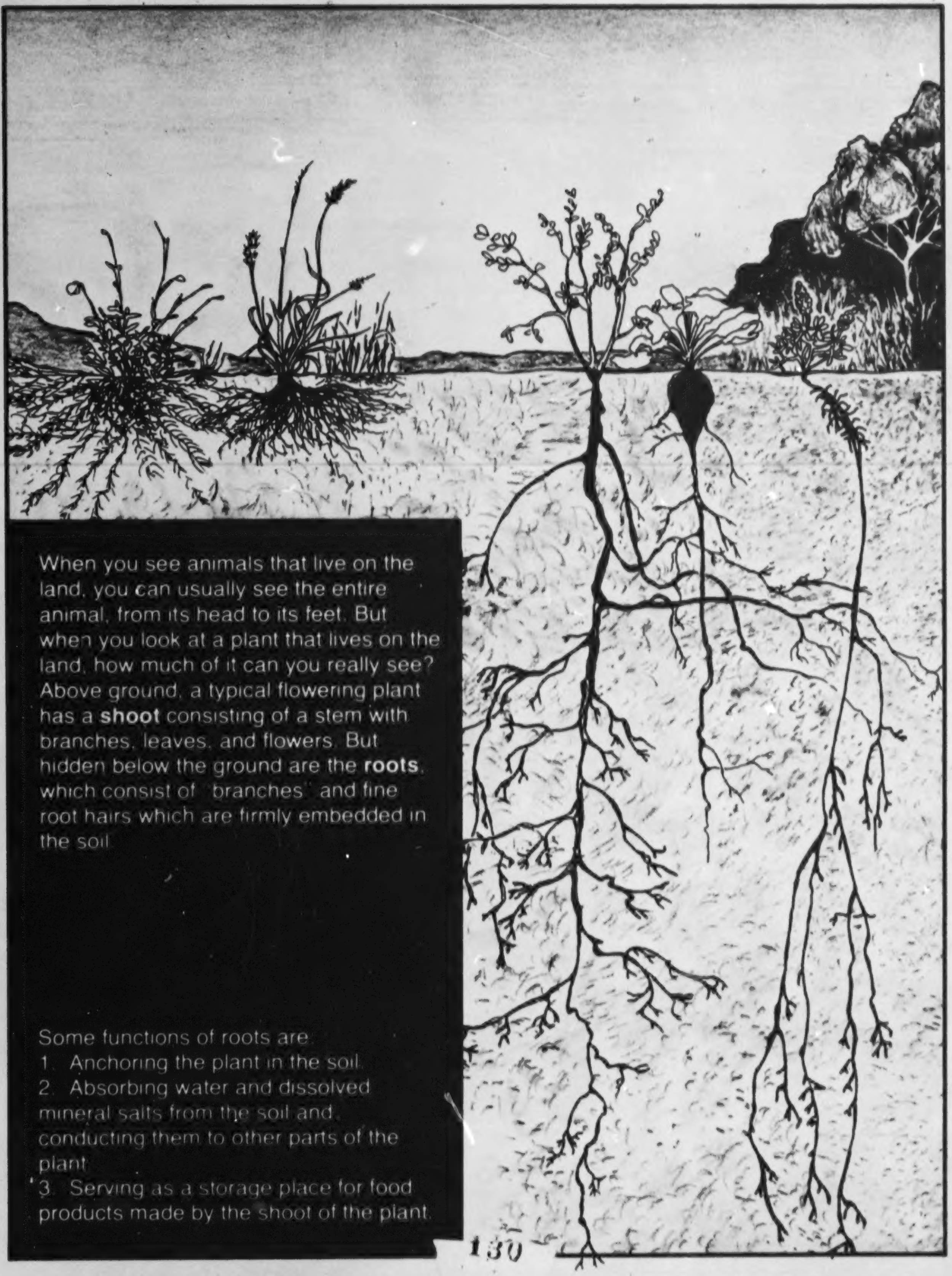


When you see animals that live on the land, you can usually see the entire animal, from its head to its feet. But when you look at a plant that lives on the land, how much of it can you really see? Above ground, a typical flowering plant has a **shoot** consisting of a stem with branches, leaves, and flowers. But hidden below the ground are the **roots**, which consist of "branches" and fine root hairs which are firmly embedded in the soil.

Some functions of roots are:
1. Anchoring the plant in the soil.
2. Absorbing water and dissolved mineral salts from the soil and conducting them to other parts of the plant.
3. Serving as a storage place for food products made by the shoot of the plant.

Different types of plants have different patterns of root growth. Grasses, including cereals such as wheat, oats, corn, and rice, usually have slender, fiber-like roots with no one root more prominent than others. This type of root structure is a **fibrous root** system. Other plants, such as the dandelion (a weed) or food crops such as carrots, beets, and radishes, have one large main root, called a **tap root.** A tap root plant can store large amounts of food in this large root. Roots also inhibit soil erosion caused by wind and water.

The same type of plant growing under different **environmental conditions** (such as different soil texture or amount of moisture in the soil) often shows variation in its root system. For example, a plant growing at the edge of a pond may have a shorter root system than the same plant growing in drier soil. Near the pond, water is available much closer to the soil surface and the root has little stimulus to grow further.

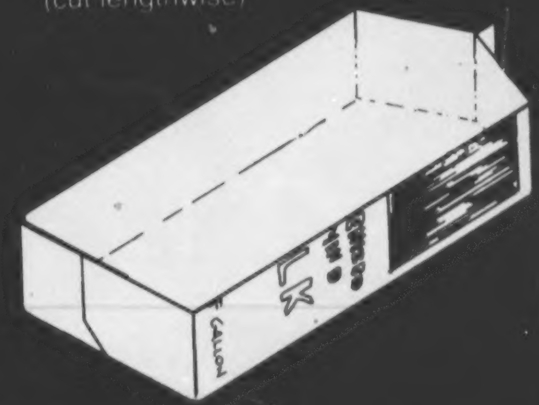
FIND PLANTS WITH ROOTS LIKE THOSE OF TWO MYSTERY PLANTS.

Roots and Shoots is a weed activity designed to motivate youngsters to investigate roots. Using the roots as their only clues, the teams seek to identify two mystery plants by digging and uncovering roots that match those of the mystery plants.

MATERIALS

For each team of two:

1 trowel
1 milk-carton half
(cut lengthwise)



Optional:

1 hand lens

For the group:
2 large brown paper bags
• tape or string
(to close the bags)
1 bucket of water
1 set of Action Cards

Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

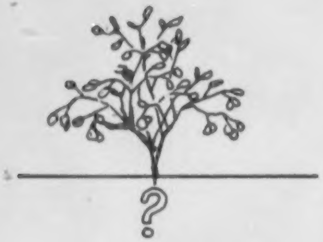
The best site for this activity is a weedy lot, lawn, garden, or an old field. Be sure to obtain permission, if necessary, to dig up the weeds in your study site.

ROOTS AND SHOOTS
Action Card #1

Outdoor Biology
Instructional Strategies

FIND:

a plant with a new type of root system, one that has not been found.



ROOTS AND SHOOTS
Action Card #2

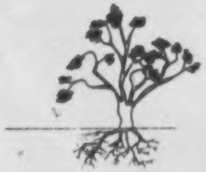
Outdoor Biology
Instructional Strategies

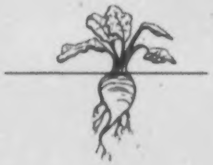
FIND:

a plant with a thicker main shoot than main root,

and

a plant with a thicker main root than main shoot.





ROOTS AND SHOOTS
Action Card #3

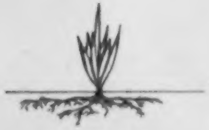
Outdoor Biology
Instructional Strategies

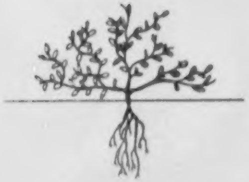
FIND:

a plant with a wider root system than shoot system,

and

a plant with a wider shoot system than root system.





ROOTS AND SHOOTS
Action Card #4

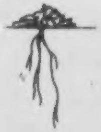
Outdoor Biology
Instructional Strategies

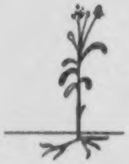
FIND:

a plant with longer roots than shoot,

and

a plant with a longer shoot than roots.



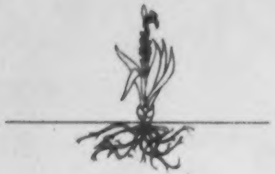


ROOTS AND SHOOTS
Action Card #5

Outdoor Biology
Instructional Strategies

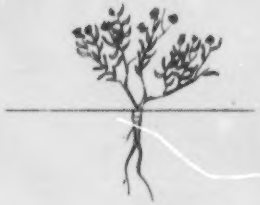
FIND:

a plant with more root branches than shoot branches,



and

a plant with more shoot branches than root branches.



ROOTS AND SHOOTS
Action Card

Outdoor Biology
Instructional Strategies

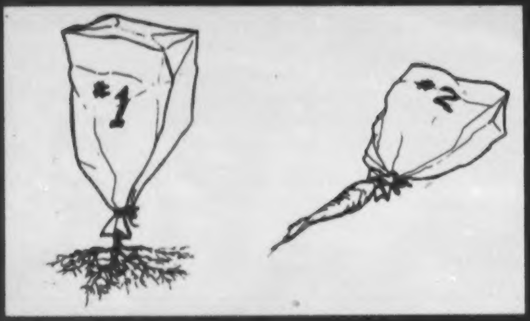
ROOTS AND SHOOTS
Action Card

Outdoor Biology
Instructional Strategies

ROOTS AND SHOOTS
Action Card

Outdoor Biology
Instructional Strategies

Dig up two plants: one with fibrous roots (a grass plant) and one with a tap root (dandelion, carrot). Place a brown bag over each plant shoot so that only the roots are exposed. Secure the bag tightly with tape or string. The fibrous-root plant will be Mystery Plant #1, the tap-root plant, Mystery Plant #2.



ACTION

1. Explain to the youngsters that they will investigate the weeds in their study site, particularly that part of the plant they rarely see, the **roots**. Tell them that the above-ground part of the plant is the **shoot**, which consists of the stem, branches, leaves, and flowers.

2. Introduce Mystery Plant #1 to the group. Explain that the shoot is inside the bag; only the roots are exposed. Ask the group for a descriptive name to use when referring to the plant's roots.

3. Define the limits of the study area and point out the plants, if any, that should not be disturbed. Divide the group into teams of two. Challenge each team to find several different plants with root systems like that of the Mystery Plant. Encourage the teams to bring back for comparison all the plants they dig up. Distribute a trowel to each team and let the digging begin.

4. Wander from team to team, encouraging the youngsters to take the time to get all the roots with the shoot. You might want to ask some questions as you visit the teams. Does the soil cling to some types of roots more than to others? Do your plant's roots look like the Mystery Plant's roots? If not, how do they differ? Do you think your plant is the same kind as the Mystery Plant? (Washing the roots in a bucket of water to remove soil makes closer examination possible.)

5. When all the youngsters have washed and compared their roots, have them form a root "lineup," grouping those plants with roots similar to Mystery Plant #1.

6. Introduce Mystery Plant #2. Ask the group for a descriptive name for these roots and challenge the teams to find plants with similar roots. Have the teams follow the same procedure of investigation they used with Mystery Plant #1, ending with another root lineup.

7. Ask the youngsters to guess the identity of the two Mystery Plants. Can the kids tell what the shoot looks like when they can only see the roots? Let the suspense build as they guess, then uncover the mystery shoots. Who was correct?

8. One final challenge: To each team, distribute one action card and milk-carton half. Have each team bring back the plants described on its card.

9. Optional: Have each team explain how its plants fit the challenge on the card. Point out some of the more unusual roots found. Provide hand lenses for observation.

GETTING TO THE ROOT OF THE MATTER

☐ How would you explain two plants of the same kind that have roots that are *not* the same?

☐ Why do you think there are so many variations in root systems?

☐ Did you find any animals near the roots of the plants? What do you think the animals were doing there?

☐ How do animals, including man, use plant roots? Have you ever eaten a root?

☐ What kind of root would you design for dry soil? Sandy soil? Wet soil? Hard soil? No soil?

DIGGING DEEPER

1. Make sunprints of the roots. This could be the start of another mystery game.
2. Explore the differences in root systems in a managed and an unmanaged area. (See *Out of Control*, Set I.)
3. Germinate some seeds on a moist paper towel. Which comes first, the root or the shoot.

WHAT TO DO NEXT

	Set
Gaming in the Outdoors	*II*
Plant Patterns	*II*
Seed Dispersal	*I*
Invent a Plant (consider roots)	*I*

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

Waves, currents, surf, tides, and winds constantly reshape beaches. Sandy beaches particularly are characterized by heavy wave action and rapidly shifting sand. Organisms are scarce on these surf-swept beaches because of the lack of stationary objects on which to anchor. However, bits and pieces of organisms from more hospitable environments often litter these beaches. Where do these remnants of organisms come from and how do they reach your activity site? This activity invites your participants to discover if the motions of the sea could be responsible for transporting this organism debris.

INVESTIGATE THE MOTIONS OF THE SEA.

PREPARATION

In this activity, the group uses simple devices to investigate oceanic motions along the beach. (You can easily adapt this activity to large lakes with debris-littered shores. Choose a day with good wave action to do the activity.) With the exception of the fishing equipment (which you can usually borrow) the suggested equipment is relatively inexpensive and easy to obtain. If you cannot acquire all the suggested materials, run the activity with the items you can obtain. The group can help you accumulate and set up the equipment. (See the "Seas in Motion" equipment cards in the *OBIS Toolbox* folio.) Setting up before you reach the seashore will allow you more investigating time on the beach.

MATERIALS

For the group:

4 meter sticks or tapes
4 waterproof marking pens
4 watches with second hands
• pencils
2 tide tables (available from local fishing or diving shops)
• Action Cards (duplicated—1 card per team)
• Equipment Cards (duplicated)

For special devices:

• balloons
• old tennis balls
• sand and tide stakes
• marked shells
• dye markers
• colored sand

Optional:

• fishing rods
• tossing cups

*See the "Seas in Motion" equipment cards in the *OBIS Toolbox* folio for instructions on construction or use and additional materials required.

SEAS IN MOTION
Action Card #1

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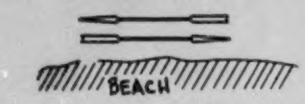
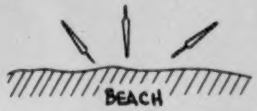
Instructional Strategies

Speed and Direction of Currents. Is there a current running parallel to the beach? Hand toss or use a fishing rod to cast tennis balls, water balloons,* or floating dye markers* into the surf. Use a watch and meter stick or tape to estimate their speed (meters per minute) and main direction of movement. Fling objects into several different surf spots and compare the estimated speed and direction of movement in different areas.

PARALLEL CURRENTS



NON-PARALLEL CURRENTS



*See the "Water Balloons" and "Dye Markers" equipment cards in the *OBIS Toolbox* folio.

SEAS IN MOTION
Action Card #2

Outdoor Biology
Instructional Strategies

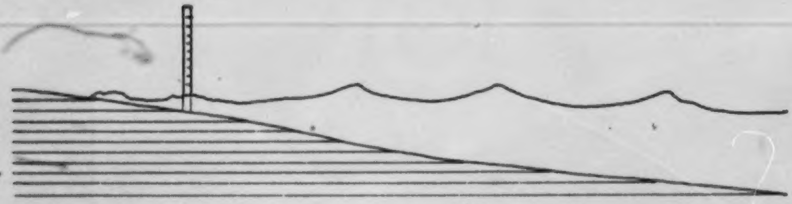
Movement of Floating Objects. Are floating objects tossed up on the beach or taken out to sea? Hand toss water balloons* (nearly full) or tennis balls into the surf and find out where they go.

*See the "Water Balloons" equipment card in the *OBIS Toolbox* folio.

SEAS IN MOTION
Action Card #3

Outdoor Biology
Instructional Strategies

Measuring Tidal Changes. Is the tide coming in or going out? Set up tide stakes* to measure both the vertical tidal change (height) and the horizontal tidal change (movement of the water lap line) during the activity period.

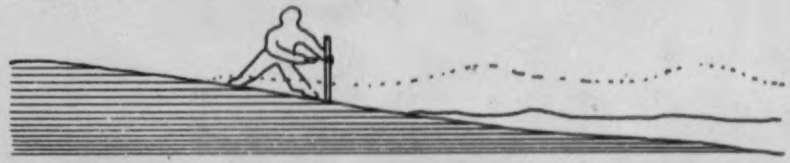


*See the "Tide Stakes" equipment card in the *OBIS Toolbox* folio.

SEAS IN MOTION
Action Card #4

Outdoor Biology
Instructional Strategies

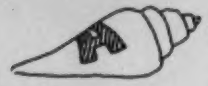
Sand Movement. Is the water moving the sand on or off the beach? To find out, you can put sand stakes* in the area between the highest point the water reaches and the lowest point to which the water recedes on each wave. Currents can be dangerous so work your way out slowly and stop before the water level reaches the top of the 60-cm stake planted in the sand.

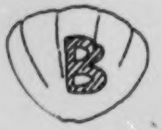


*See the "Sand Stakes" equipment card in the *OBIS Toolbox* folio.

SEAS IN MOTION
Action Card #5

Shell Movement. What happens to shells when you toss them into the surf? How far up or down the beach do they move? Mark both sides of some shells with waterproof markers and use the screen-bottomed container* to toss the shells into the surf. See where they turn up.





*See the "Tossing Cup" and "Marked Shells" equipment cards in the *OBIS Toolbox* folio.

SEAS IN MOTION
Action Card #6

Floaters and Non-Floaters. What happens to floating, sinking, and neutrally buoyant objects when you toss them into the water together? Use freshwater balloons* or tennis balls as floating objects, salt-water balloons* as neutrally buoyant objects, and bundles of shells as sinking objects. Hand toss the objects. Time their motions and measure the distances that they cover.

	DISTANCE	TIME
FLOATING		
NEUTRAL		
SINKING		

SEAS IN MOTION
Action Card #7

Movement of Materials. What happens to bits and pieces of organisms when they are tossed into the water? Measure the distances covered and speed of travel.

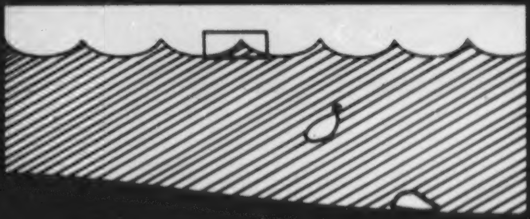
ITEM	DISTANCE	TIME

SEAS IN MOTION
Action Card

WATER ACTION

1. Draw attention to the bits and pieces of organisms (shells, seaweed, feathers, crab and fish skeletons, etc.) that are scattered along the beach. Ask your group how these organism remnants might have reached your activity site.

2. Tell the participants they are going to investigate the possibility that the motions of the sea carried the organism remnants ashore. The investigation involves tossing floating, sinking, and neutrally buoyant (does not sink or float) objects into the water off the beach and observing the results.



3. Mark the limits of the activity site; a 30- to 100-meter length of unobstructed beach should be ample. (Always keep the kids in plain view.) Tell the participants to stay within the limits of the activity site.

4. Introduce and demonstrate the various pieces of equipment.

5. Form buddy teams and hand out an action card to each team. Each team should collect the equipment necessary to carry out the activity described on its action card.

6. Let the teams start their investigations. Lend assistance when needed. While keeping an eye on the teams, participate in the investigation yourself.

7. If some teams complete their action cards before the end of the period, give them additional cards or let them exchange cards with other teams.

FATHOMING IT ALL

Call the participants back to share discoveries when the investigations are completed.

Which way was the current running (parallel or non-parallel to the beach) and how fast?

Was the tide coming in or going out? (Verify with tide table.)

Is the sand moving? In or out?

How do the movements of floating, sinking, and neutrally buoyant objects compare?

Did the marked shells reappear? If so, do you think they were moved by current or waves?

To wrap up the discussion, ask for informed guesses:

1. How might conditions differ on an incoming tide? Outgoing? Stormy day?
2. Where might bits and pieces of organisms have come from? Where should we go to look for some living organisms?

FOLLOW THROUGH

1. Go to the site the kids thought the organisms came from and conduct an organism hunt. Do results verify or refute their informed guesses?
2. Do this activity again on a different tide.
3. Return to the site during a minus tide to observe the shape and profile of the beach. Try to relate the shape of the beach to water movement off the beach.

WHAT TO DO NEXT

	Set
Beach Zonation	*II*
OBIS Oil Spill	*II*
Rock Pioneers	*II*
Seed Dispersal	*I*

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Berkeley California

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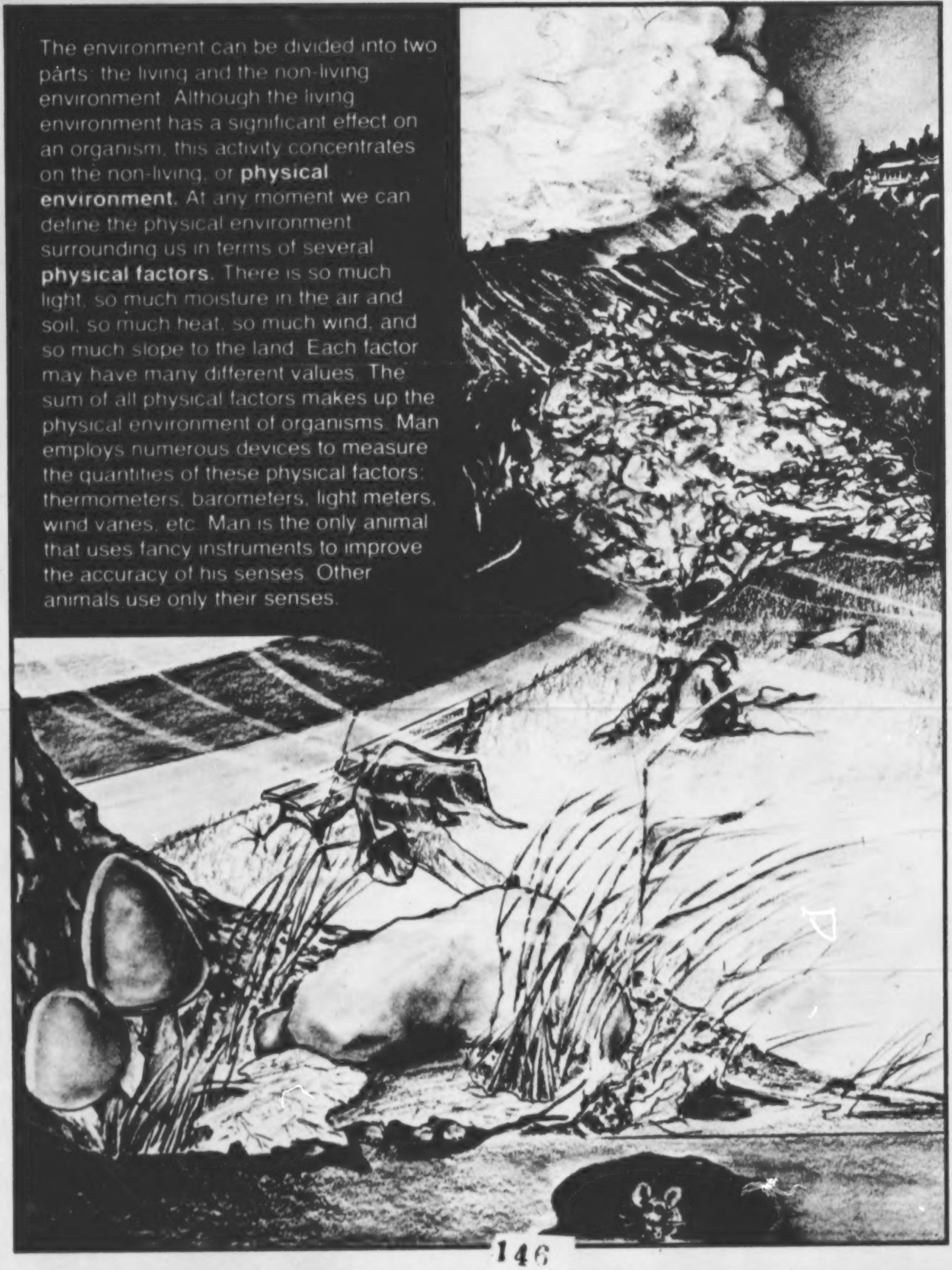
The environment can be divided into two parts: the living and the non-living environment. Although the living environment has a significant effect on an organism, this activity concentrates on the non-living, or **physical environment.** At any moment we can define the physical environment surrounding us in terms of several **physical factors.** There is so much light, so much moisture in the air and soil, so much heat, so much wind, and so much slope to the land. Each factor may have many different values. The sum of all physical factors makes up the physical environment of organisms. Man employs numerous devices to measure the quantities of these physical factors: thermometers, barometers, light meters, wind vanes, etc. Man is the only animal that uses fancy instruments to improve the accuracy of his senses. Other animals use only their senses.



USING ONLY YOUR SENSES, FIND THE HIGHEST AND LOWEST VALUES (EXTREMES) FOR SEVERAL PHYSICAL FACTORS IN YOUR STUDY SITE.

In this activity, you and your youngsters use *only your senses* to investigate your local environment and discover the physical factors you respond to most strongly. OBIS suggests two different techniques for organizing your Sensory Hi-Lo Hunt: (A) Use flags to mark the locations of highs and lows right in your study site. (B) Use an outline map of your study site to record highs and lows. After locating highs and lows, each youngster goes back into the site to respond "like an animal" to the environment. Finally, the group searches for animals and investigates the physical factors which affect the animals.

PREPARATION

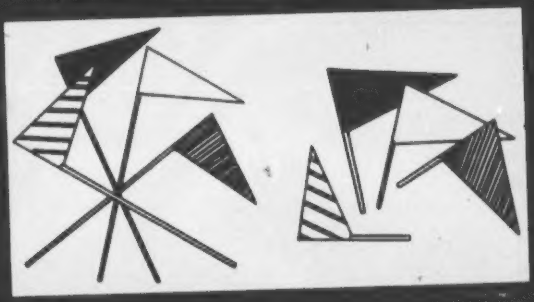
A good activity to precede this one is *Terrestrial Hi-Lo Hunt* (Set I).

The best site for a Sensory Hi-Lo Hunt is one with a diversity of vegetation and physical features. This is a good activity for a very hot, cold, windy, rainy, or snowy day, as opposed to a pleasant, calm day.

MATERIALS

Method A (Flags)

8 marker flags, 4 different colors, 1 tall and 1 short of each color



Method B (Map)

1 data board
4 felt-tip pens, 4 colors

ACTION

Method A: Flags

1. Define the limits of your study area, and tell your participants they are going to investigate their environment. Ask the youngsters to think of their environment as made up of physical factors such as wind, temperature, light, moisture, and slope. **Physical factors** are the non-living parts of the environment that affect living organisms.

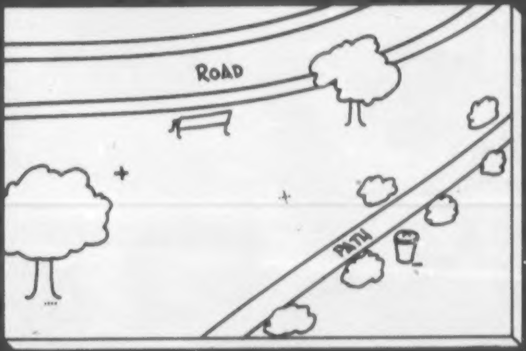
2. Hold up your flags, a long one and a short one of each color. Tell the youngsters they are going on a Hi-Lo Hunt to investigate the physical factors in their area. Hi-Lo Hunts go like this: Each physical factor will have a high value in one place and a low value in another place. For example, moisture: There will be a wettest place (high) and a driest place (low) in your study area. Similarly you can find a windiest spot (high) and a calmest spot (low). Divide your group into teams, distribute two flags to each team (a tall one for high and a short one for low), assign a physical factor to each team, and send them into the site to discover highs and lows. Have them plant their flags in the appropriate high and low spots.

3. Call the group back when all hi-lo's have been flagged. Ask the participants how they discovered the high and low of their factors (senses: touch, sight, hearing, etc.). Tell the kids to go back into the study site and, again using their senses, find their "spots." Each kid's spot should be the place he would like to spend some time, the place he would be most comfortable, the place where the physical factors are most inviting.

4. Call the group back and discuss the factors in the environment that affected each kid's "spot" selection. When everyone has had a chance to explain his or her rationale for "spot" selection, suggest that other animals might be living in the study site occupying "spots" of their own. Go back into the site and find animals. Encourage the youngsters to identify the physical factors these animals seem to respond to. Look for animals in the open, in and under objects, and in cracks.

Method B: Map

When using the map method, the youngsters follow basically the same plan as the flag method. Instead of flagging the locations, however, the kids record highs, lows, and "spots" on an outline map of the study area.



QUESTIONS to ask while kids investigate animals in the study area.

Which physical factors do you think are most important to the animal you found?

If you remove an animal from its "spot," what does the animal do?

How do animals found in the open sunlight respond to a shadow that falls on them?

Which animals seem to like the same environment that you like?

WHAT DO YOU THINK?

☐ **Environmental Variables.** Ask the participants: "Will this spot (high temperature spot) be the warmest tonight? Next week at this time? Will this spot always be the windiest? Will the wind always be from the same direction?" Suggest that the physical factors in your environment may vary from minute to minute, day to day, or month to month, and are called **environmental variables.** In fact, as you have found, you have a variation of temperature, moisture, wind, etc., in your study site right now.

☐ **Habitat.** If the youngsters are not familiar with the term **habitat**, tell them it is the place where a plant or animal lives. Ask the youngsters how they think the animals select their habitats. Why does one plant appear in one habitat and not in another?

☐ Would you have chosen the same "spot" on a rainy day? Hot, sunny day? Windy day? At night? Why?

☐ How does man cope with hostile environments? Does he change the physical factors or modify his behavior? How do other animals adjust to extremes of environmental variables (hibernate, migrate, grow more fur, bathe in water)?

FOLLOW THROUGH

By conducting some simple experiments, test your ideas on the variables that evoke the strongest response from animals in your study site. Do the isopods under the log respond to light or moisture? How can you find out? Do ants respond to light or temperature? How can you find out?

WHAT TO DO NEXT

	Set
Plant Patterns	*II*
Rock Pioneers	*II*
Habitat Sun Prints	*I*
Sticklers	*I*

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Berkeley California

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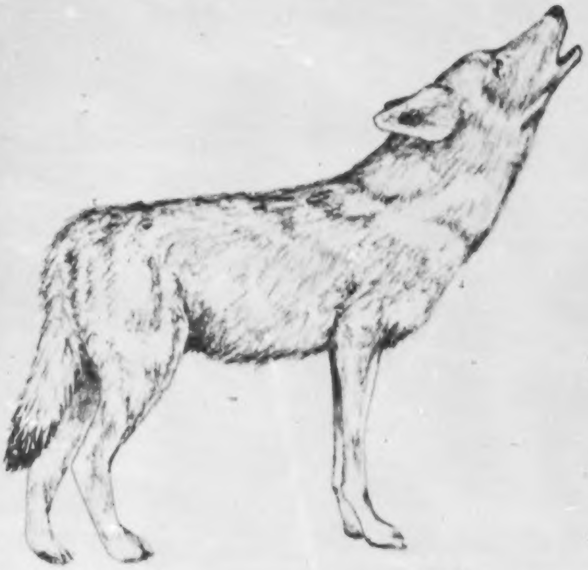
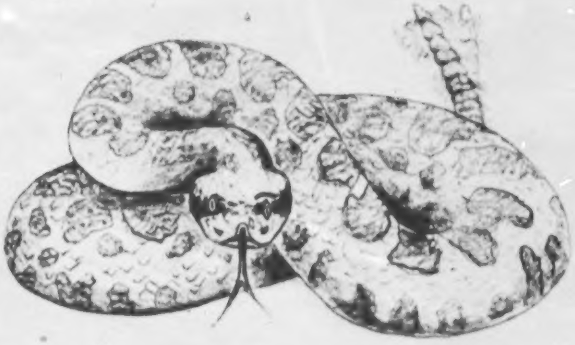
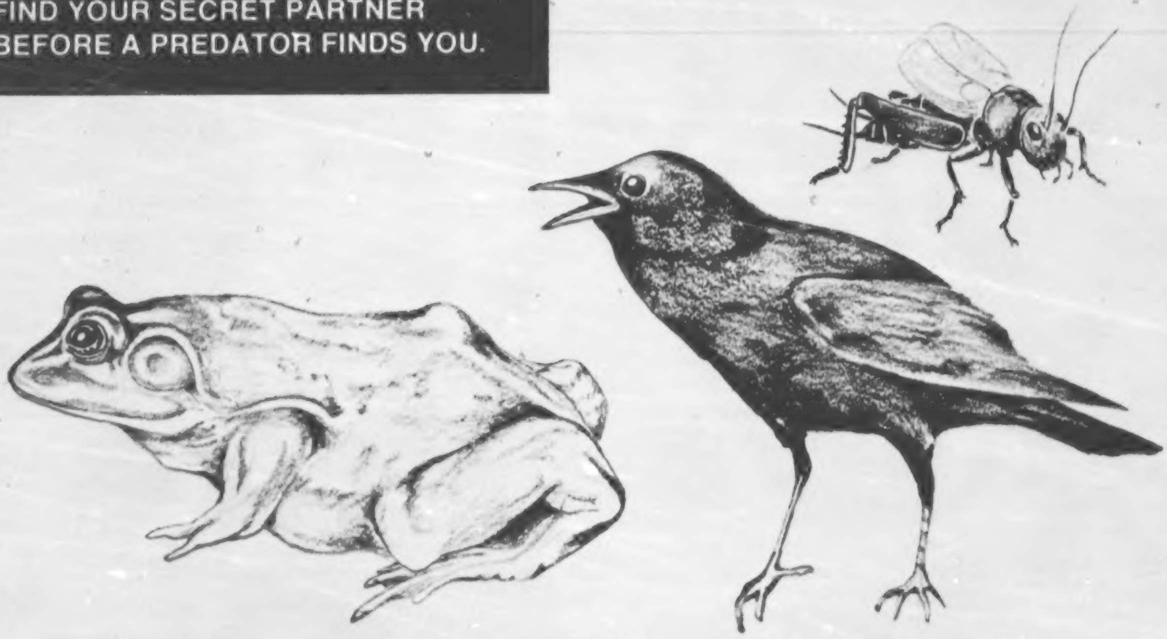
A cricket chirps, a frog "ribbets," a snake hisses, a crow caws, and a wolf howls. These sounds are distinctive and particular to these animals. Through these sounds, animals communicate not only with members of their own kind, but also with other animals. What do these sounds communicate? The frog's "ribbet" and the cricket's chirp are male mating calls, which attract females of their kinds and warn male rivals. The crow's caw is often a warning alarm evoked by the sight of a predator. The snake's hiss warns possible predators to stay away. The wolf's howl may signal to the pack that prey has been found or may greet other members of a family.

A keen sense of hearing is useful to animals with poor vision, animals that are active at night, and animals living in dense forests or other dark habitats.





FIND YOUR SECRET PARTNER BEFORE A PREDATOR FINDS YOU.



This activity introduces the concept of animal sound communication through a hide and seek game. Secret partners try to find each other using only their sound signals and their sense of hearing. You can play the game at night or during daylight hours. It is important to follow up *Sound Off* by listening for natural animal signals.

MATERIALS

For the group:

1 ball of string
1 cardboard box
1 pencil
- several pieces of paper (for predator signs)

2-3 each of several different kinds of noise makers such as whistles, horns, rattles, milk cartons with a rock inside each; aluminum cans. (There should be one for each kid plus a few extras for rule changes.)

Alternative noise makers:

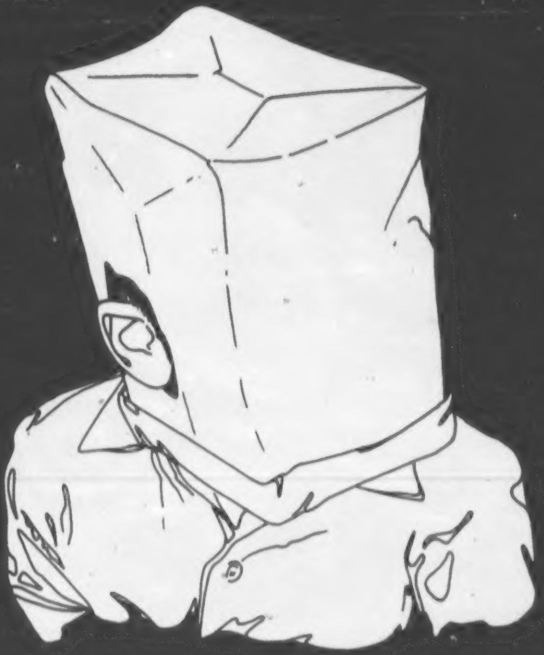
- hand clapping, finger snapping, whistling. If you use these processes, write each signal on two or three slips of paper and put them in the box.

For daylight activity:

1 brown paper bag (head size) for each youngster
2-3 pairs of scissors
2-3 pencils

PREPARATION

1. *Sound Off* requires a minimum of ten participants and works even better with more.
2. The game is a good nighttime activity because darkness limits the youngsters' vision. Dark nights with little moonlight are best. If you play the game during the daylight hours, provide bags for masks. The masks should allow the youngsters to see only straight down to their feet. Roll up the bags to fit and cut out ear holes.



3. Choose an activity site with some bushes and trees, but no dangerous slopes or tricky obstacles. The area should be large (approximately 40 m x 40 m) and relatively equal in dimensions, i.e., not too narrow.
4. To make the noise-maker selection fair to all players, tie a piece of string (30 cm long) to each noise maker and predator sign (piece of paper marked "predator"). Start out with just one

predator. Place all items, with their strings attached, into the box so the strings hang over the edge of the box. This procedure eliminates "feeling" for the favorite noise maker.

ACTION

1. Introduce animal sound communication. Ask the participants to imagine they are animals with poor vision or animals active only at night when vision is restricted. What other senses might they rely on to survive?
2. * For daytime activity: Show the kids how to make a mask that restricts vision. Distribute the brown bags and scissors. Allow the youngsters to practice walking around with masks on. (If you are doing this as a nighttime activity, ignore all references to masks.)

Hide and Seek

Call the participants together (masks off) and introduce the Hide and Seek game. Designate an area outside the game zone as the CAPTURED area.

1. Display the noise makers and predator signs. Discuss what is meant by **predator** (animals that eat other living organisms) and **prey** (food eaten by predator). Tell the participants that they will try to find their partners and avoid being captured by the predator.
2. Have everyone put on a mask and, in turn, select a string from the box. No one else is to know what each other has. Everyone should be silent!
3. The participants hold hands and form a line (masks still on). The leader starts a "snake walk" and keeps dropping off the first person in line as the walk proceeds. In this way players are scattered over the entire activity site. (For a night activity, the players can individually scatter as soon as they have their noise makers or signs.)
4. Give the signal to "Sound Off!" The object of the game is to find the animal that makes the same noise as you do (your secret partner), and to stay with your partner without being tagged (eaten) by the predator) until the game is over. Each game represents a lifetime for the animals.
5. A few rules:
   a. Everyone can move freely, but no running is allowed!
   b. You can "sound off" only when standing still, not while moving.
   c. No peeking!
6. If the predator tags you, take off your mask and move to the CAPTURED area. Predators must be sure the prey know they have been tagged. If partners find each other before the predator does, they must stay together and continue to avoid the predator until the game is over.
7. The game is over when the leader calls "time." For the first few games, allow about five minutes. Thereafter alter the time period according to the youngsters' suggestions.
8. Play the game a number of times, changing roles each time. The youngsters may want to modify the rules also. Some suggestions are:
   a. Each predator can eat only certain animals (making certain noises).
   b. Predators must make noise whenever they are moving. (Select a suitable predator noise maker, label it "predator" and put it in the box with other noise makers. Everyone must be able to recognize the predator's sound.)
   c. Increase the number of predators.

d. Change the **distribution** of the predators and prey (the way they scatter over the area.)

e. Give one or two prey the ability to free other prey that are caught. This simulates reproduction for those prey that escape being eaten.

f. Change the time allowed for each game.

WHAT DO YOU THINK?

1. Which signals worked best in attracting and finding partners?
2. How did you successfully avoid a predator?
3. Besides attracting a partner, what else might animals be communicating to each other?

FOLLOW THROUGH

At twilight, or after dark, quietly listen for animal sounds and signals.

☐ Track down an animal sound.

☐ Try to determine if there are two or more animals communicating.

☐ Try to mimic a call or sound and see if you get a response.

WHAT TO DO NEXT

	Set
Birdfeeder	*II*
Old White Sheet Trick	*II*
Attention!	*I*

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
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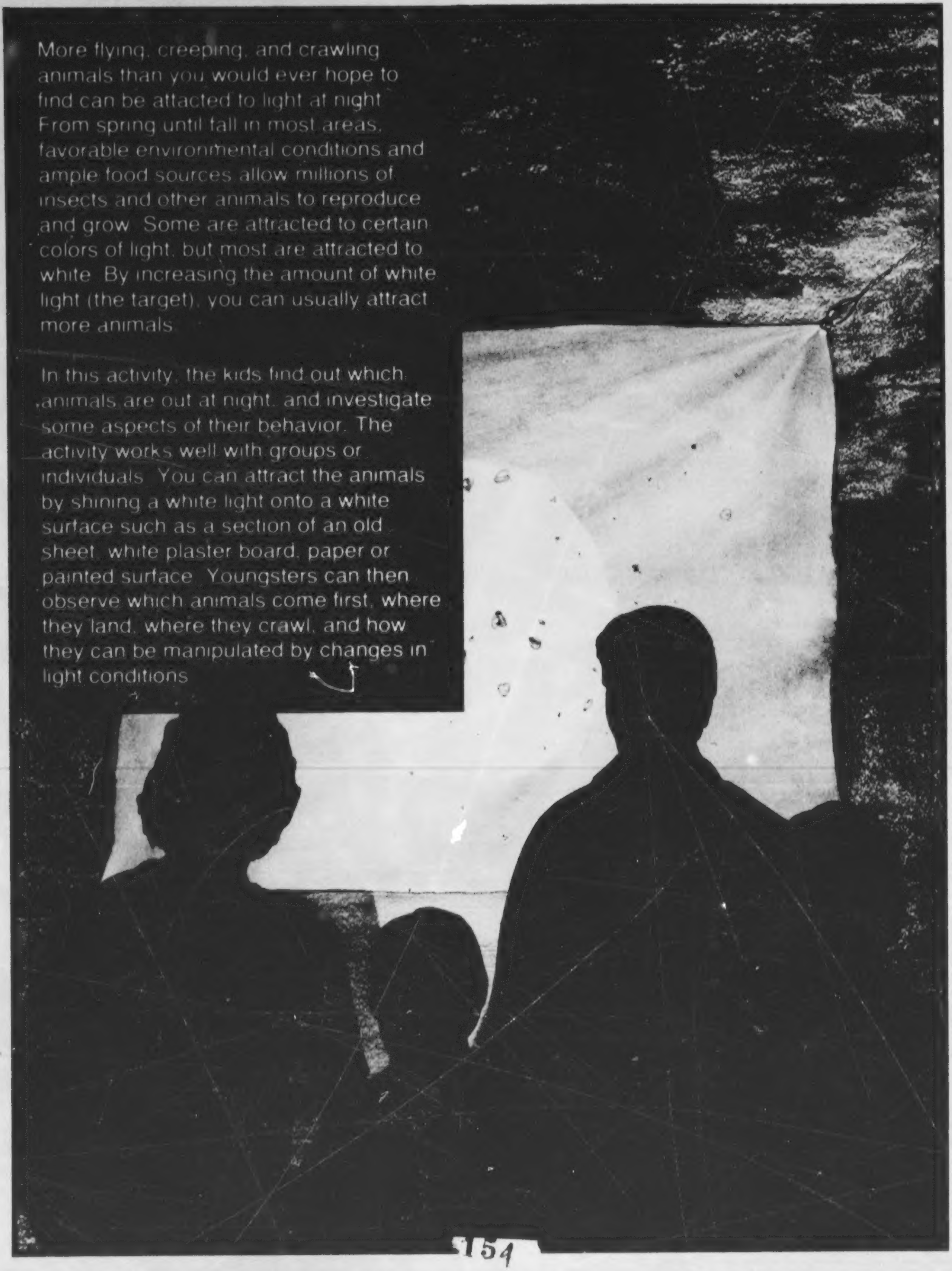


More flying, creeping, and crawling animals than you would ever hope to find can be attacted to light at night. From spring until fall in most areas, favorable environmental conditions and ample food sources allow millions of insects and other animals to reproduce and grow. Some are attracted to certain colors of light, but most are attracted to white. By increasing the amount of white light (the target), you can usually attract more animals.

In this activity, the kids find out which animals are out at night, and investigate some aspects of their behavior. The activity works well with groups or individuals. You can attract the animals by shining a white light onto a white surface such as a section of an old sheet, white plaster board, paper or painted surface. Youngsters can then observe which animals come first, where they land, where they crawl, and how they can be manipulated by changes in light conditions.

There is no magic sequence of sub-tasks. The best procedure is one that allows the participants to first observe the animals. These observations will then give the youngsters ideas on what to investigate and experiment with. Action Cards are available for those who do not think of experiments.

USING A LIGHT SOURCE, ATTRACT ALL THE NIGHT ANIMALS YOU CAN.

PREPARATION

A warm, relatively windless night should be ordered for best results. Select an outside area near foliage, but in a place relatively free of objects that may cause children to trip or fall. Avoid competition from street lights, cabins, and other light sources. Find the best place to suspend the white sheet. It should hang freely (as opposed to hanging flat against a wall), so you can shine the light through the sheet. Let part of the sheet lie on the ground to catch falling animals. Duplicate the action cards and cut them apart.

MATERIALS

For the group:

- junk box containing such things as paper and cloth of various colors, tape, scissors, felt pens, various smelly things (onions, fingernail polish, vinegar, garlic, diluted ammonia, etc.), cotton swabs, popsicle sticks, soda straws, colored gels or celophane, aluminum foil pieces, and pencils

1 old white sheet (best), or white butcher paper, tagboard, or cardboard painted white

- materials for hanging the white surface (sheet — clothesline, cardboard — nails, tacks, or tape, etc.)
- electric lamps, flashlights of various types and intensities, auto headlights, and camp lanterns. A blacklight such as the one described in *Who Goes There?* (Set I) will produce a strange effect to see but will not attract many animals. You can use any safe source of light you can find. For safety reasons, we discourage the use of flame.
- Action Cards (duplicated)

Optional

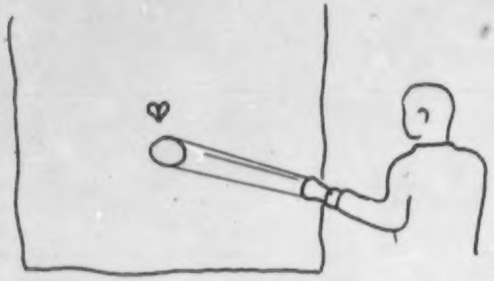
- hand lenses
- clear containers with caps

Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

THE OLD WHITE SHEET TRICK
Action Card #1

Outdoor Biology
Instructional Strategies

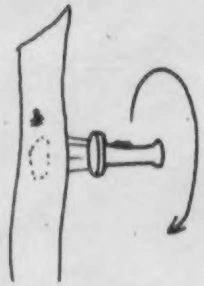
Use light to get one type of animal to move where you want it.



THE OLD WHITE SHEET TRICK
Action Card #2

Outdoor Biology
Instructional Strategies

Shine the light through the sheet. How does moving the light around affect the animals? (Move the light slowly.)



THE OLD WHITE SHEET TRICK
Action Card #3

Outdoor Biology
Instructional Strategies

Check the descriptions below that apply to animals that spend most of their time flying around.

____ Big
____ Small
____ Long
____ Short
____ Brightly colored
____ Plain

____ 6-legged
____ 4-legged
____ Big eyes
____ Small eyes
____ Big wings
____ Small wings

THE OLD WHITE SHEET TRICK
Action Card #4

Outdoor Biology
Instructional Strategies

How do the animals act when they are:
a. in the brightest spot?
b. on the sheet, but away from the brightest spot?
c. captured and released one, two, and three meters away from the lighted sheet?

THE OLD WHITE SHEET TRICK
Action Card #5

Outdoor Biology Instructional Strategies

Place different colors of gel or cellophane over a flashlight and see which colors attract animals.

Color tried	Attracts	Doesn't Attract

THE OLD WHITE SHEET TRICK
Action Card #6

Outdoor Biology Instructional Strategies

Do smelly things such as vinegar, onions, sweaty socks, assorted human foods, perfume, etc., attract animals that come to light?

Smelly things	Made-up name of animal

THE OLD WHITE SHEET TRICK
Action Card #7

Outdoor Biology Instructional Strategies

Change the brightness of your light by masking it with paper or cloth. How does a change in brightness affect the light's ability to attract animals? If the lamp is hot, don't let the mask touch the bulb.

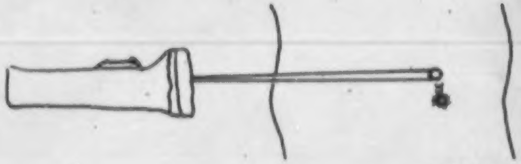
Bright ____________________
Less Bright ____________________
Dull ____________________
Very Dull ____________________
Off ____________________

THE OLD WHITE SHEET TRICK
Action Card #8

Outdoor Biology Instructional Strategies

Using aluminum foil, make a mask for your light. Poke a small hole in the foil so a small ray of light shines through. Move the ray of light across the sheet and see if you can get an animal to follow the light.

Try other sized holes.

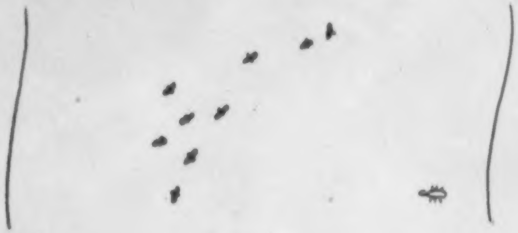


THE OLD WHITE SHEET TRICK
Action Card #9

Outdoor Biology Instructional Strategies

Of all the animals on the sheet, can you find any that seem to be staying away from other kinds?

Try getting them together to see if they separate again.



THE OLD WHITE SHEET TRICK
Action Card #10

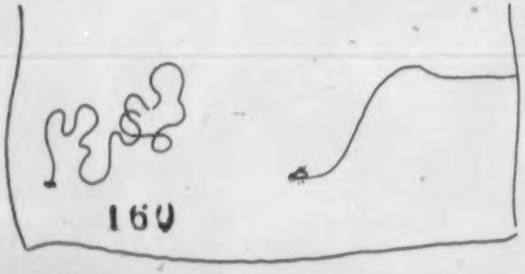
Outdoor Biology Instructional Strategies

Catch several nighttime animals and keep them in a ventilated container until morning. How do they act when released in the light?

THE OLD WHITE SHEET TRICK
Action Card #11

Outdoor Biology Instructional Strategies

Use a marking pen to trace the path of a walking animal as it moves around the sheet. Have an animal art contest.



THE OLD WHITE SHEET TRICK
Action Card #12

Outdoor Biology Instructional Strategies

Turn the light off for the length of time it takes you to count to ten. Then turn it on. What do the animals do?

Try longer and shorter counts to see how long it takes for the animals to go away.

ACTION

1. Tell the kids they are going to attract all the night animals they can by using light.
2. Ask a few of the kids to set up some lights so they shine on the sheet. Animals will probably appear either near the light sources or on the sheet soon after the lights are turned on.
3. Encourage the kids to discover which kind of animal comes first, and to compare this type with the latecomers. Allow some observation time. Watch for bats, spiders, and other animals that may come to prey on the animals attracted to the light.
4. As the kids talk or raise questions about what they see, encourage them to use materials in the junk box to experiment. They may see one animal staying near the edge of the light ring and wonder aloud if it will move when the light is moved. Encourage them to follow up on their ideas. If no ideas come from the kids, distribute the action cards.
5. Distribute one action card to each child or team and show the kids the junk box containing the materials they can use to investigate the animals' behavior around light.
6. When the youngsters complete their first action cards, they can get additional ones from you or trade with the other kids.

WHAT DO YOU THINK?

The time to stop is when interest begins to wane. If ideas, results, and excitement haven't been shared already, you might want to ask the kids what they found out about the animals.

How do late-arriving animals differ from the first ones to arrive?

What factors other than light may have attracted the animals?

What color clothes should be worn to attract the least number of night animals?

What levels of brightness attract most animals?

How do smells affect the behavior of these animals?

Do you think attraction to light is beneficial to these animals? Why?

When the animals gather at the lighted area, how do they interact (mate, fight, ignore, bump, avoid, circle each other)?

Do you suppose man could control insect populations by using light? How?

FOLLOW THROUGH

☐ Compare animals that do not come to the light with those who do by using sweepnets to collect animals from the grass, field, and bushes. Then take the collected animals to the white sheet area and compare them to the animals attracted to the light. Are non-attracted animals bigger, longer, of a different color, lacking wings or eyes? Do they have fewer legs?

☐ Catch some spiders or other known predators of insects. Bring them to the area below the sheet and see which animals they hunt, how they capture, and how many animals they eat. (Warn the children to be careful of any that might harm them.)

☐ Try the *Old White Sheet Trick* in a different location. How do the results differ?

WHAT TO DO NEXT

	Set
Animal Diversity	*II*
Attract a Fish	*II*
Who Goes There?	*II*

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

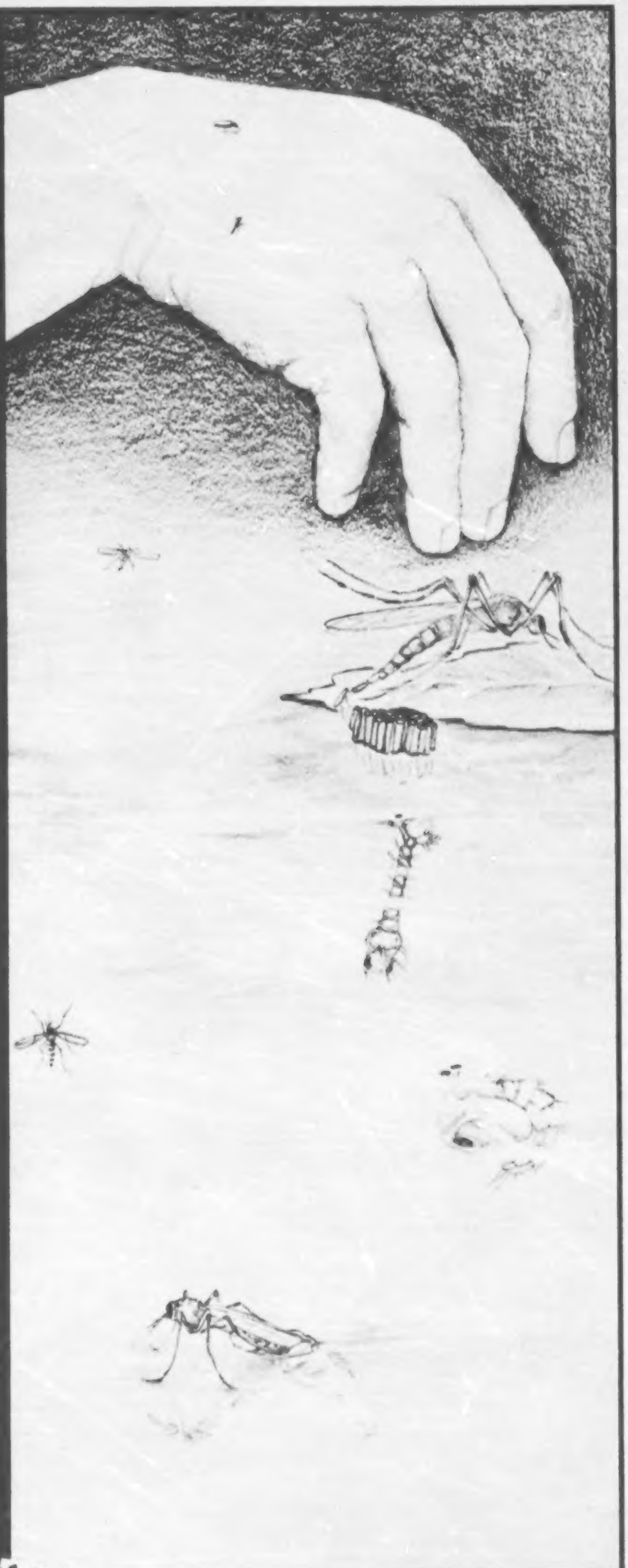
Since World War II, many chemicals have been produced to control weeds and other pests. Unfortunately many herbicides and pesticides also kill desirable organisms.

One alternative to chemicals is **biological control.** With this method of control, natural enemies regulate the population size of pest organisms: ladybugs eat aphids and the praying mantis eats a variety of garden pests. This activity introduces your investigators to biological control by challenging them to find an organism that eats mosquitoes in the aquatic wiggler stage of their life cycle.

FIND ANIMALS THAT EAT MOSQUITO WIGGLERS.

MEET THE MOSQUITO

The **life cycle** of mosquitoes (cover illustration) involves four distinct stages. **Eggs** are laid in still, fresh water and normally hatch into **larvae** within a week. One to two weeks later the larvae become **pupae.** Mosquito larvae and pupae are aquatic and both are commonly called wigglers. Within a week the pupae change into the familiar flying **adults.** The life cycle, from egg to adult, takes two to three weeks.



Mosquito-control measures usually concentrate on the aquatic stage in order to control the insect before it becomes a pest. Mosquito wigglers are eaten by dragonfly and damselfly nymphs, backswimmers, water scorpions, giant water bugs, predaceous diving beetles, water beetle larvae, and small fish. Top minnows (*Gambusias*) are such effective wiggler eaters (predators) that they are commonly called "mosquito fish." You can often obtain mosquito fish free from county mosquito abatement agencies.

SOLVING A PEST PROBLEM

You can make this activity more interesting by casting the youngsters as investigative biologists hired by the local Chamber of Commerce to solve the community's mosquito problem. Chemical sprays must be avoided because of their possible dangerous side effects. The teams are given one clue: the pond they are studying contains mystery animals that eat mosquito wigglers. The problem to solve: identify these wiggler predators.

MATERIALS

For each team of two:

1 small cup of mosquito wigglers (10-15)
1 *Pond Guide* or other identification guide
1 bug box (magnifying lens)

For each catching team of two:

1 dip net
1 dishpan or bucket (4-8 liters)

For each adding team of two:

1 turkey baster (giant dropper with rubber bulb)

PREPARATION

Two good activities to precede this one are *What Lives Here?* and *Water Holes to Mini-Ponds* (Set I). You should attempt this activity only during the warmer seasons of the year.

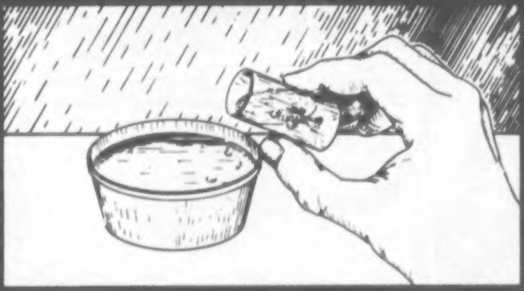
Site. The site can be any body of standing fresh water, from a lake to a dishpan filled with water. The ideal activity site, however, is a small, clear-water pond that contains mosquito fish, guppies, or some other wiggler predator. Any pond or lake that is not loaded with mosquito wigglers probably contains a variety of wiggler predators. (If you use a dishpan, you will have to add wiggler predators.) Be sure to obtain permission to use the site before the activity.

Mosquito Wigglers. You will need about twelve wigglers for each buddy team (two kids). You can easily culture your own wigglers in two to three weeks. To attract the females, which lay eggs, place a burlap-lined bucket of water in a sunny, outdoor location. When using tap water, wait one day for the chlorine to disappear, and then add a cupful of pond water. (Filter the pond water through a nylon stocking or small mesh net to avoid adding wiggler predators.) The pond water contains algae which serves as food for the wigglers. A tablespoon of nontoxic fertilizer speeds up the culturing process by providing nutrients to stimulate algae growth.

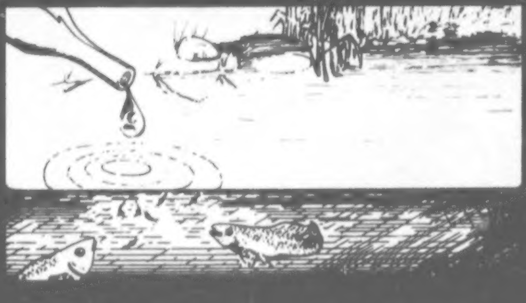
During the culturing period, keep the basin free of wiggler predators and maintain the water level. Do not place the culturing basin near resinous plants such as Laurel, Eucalyptus, Oleander, Redwood, or other "anti-mosquito" plants. Such resinous plants are poisonous to many organisms. Rafts of mosquito eggs should appear within a week.

CATCH THEM IN THE ACT!

There are two ways of investigating the mosquito problem. (1) The teams catch likely wiggler predators, place them in containers, and add the wigglers. (2) The teams add wigglers to the pond. When the water is clear enough for you to keep track of the wigglers, and when small fish (especially mosquito fish) are present, adding wigglers directly to the pond is the most successful approach.



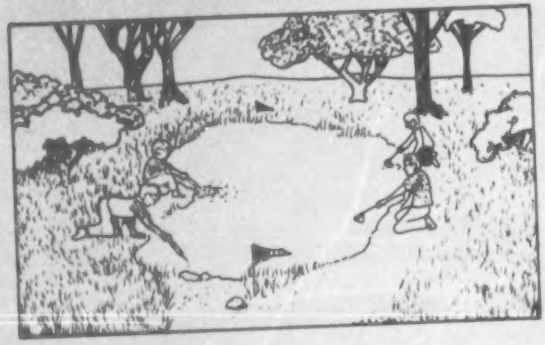
However, placing the containers in the shade for quiet observation increases the possibility of wiggler predation occurring with the other method. Tell the youngsters not to identify animals as wiggler predators until they observe the animals eating wigglers.



ACTION

1. At the activity site, briefly describe the mosquito's life cycle and outline the search for wiggler predators. (See SOLVING A PEST PROBLEM and CATCH THEM IN THE ACT sections.) Describe the two ways of investigating the problem.

2. Mark off two sections of the pond. One section is for the teams catching wiggler predators with nets and the other is for the teams using basters to add wigglers to the pond. Divide the group into buddy teams and assign each team to the appropriate section of the pond.



3. Distribute basters to the adding teams and nets to the catching teams. Hand out twelve wigglers (in small containers filled with pond water) to each team.

4. The teams can now search for wiggler predators. A team can switch its investigative approach by trading equipment with a team that is using the other approach, but each team should stick to its own section of the site.

5. Return all organisms to the pond at the end of the activity.

WHAT DO YOU THINK?

☐ After about thirty minutes, call the teams together to report their findings and make their mosquito control recommendations.

☐ Tell the group that the use of one organism to control another is called **biological control.**

☐ Tell the group that mosquitoes can fly two miles. Ask the teams what would happen if one town used control measures but the neighboring town (one mile away) did not. Would the pest problems be solved?

☐ Ask the kids for suggestions of biological controls for common household and garden pests, such as aphids, houseflies, adult mosquitoes, snails, slugs, or ants.

FURTHER INVESTIGATIONS

	Set
Attract a Fish	*II*
A Better Fly Trap	*II*
Food Chain Game	*II*
Adaptation – Predator-Prey	*I*

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Instructional Strategies
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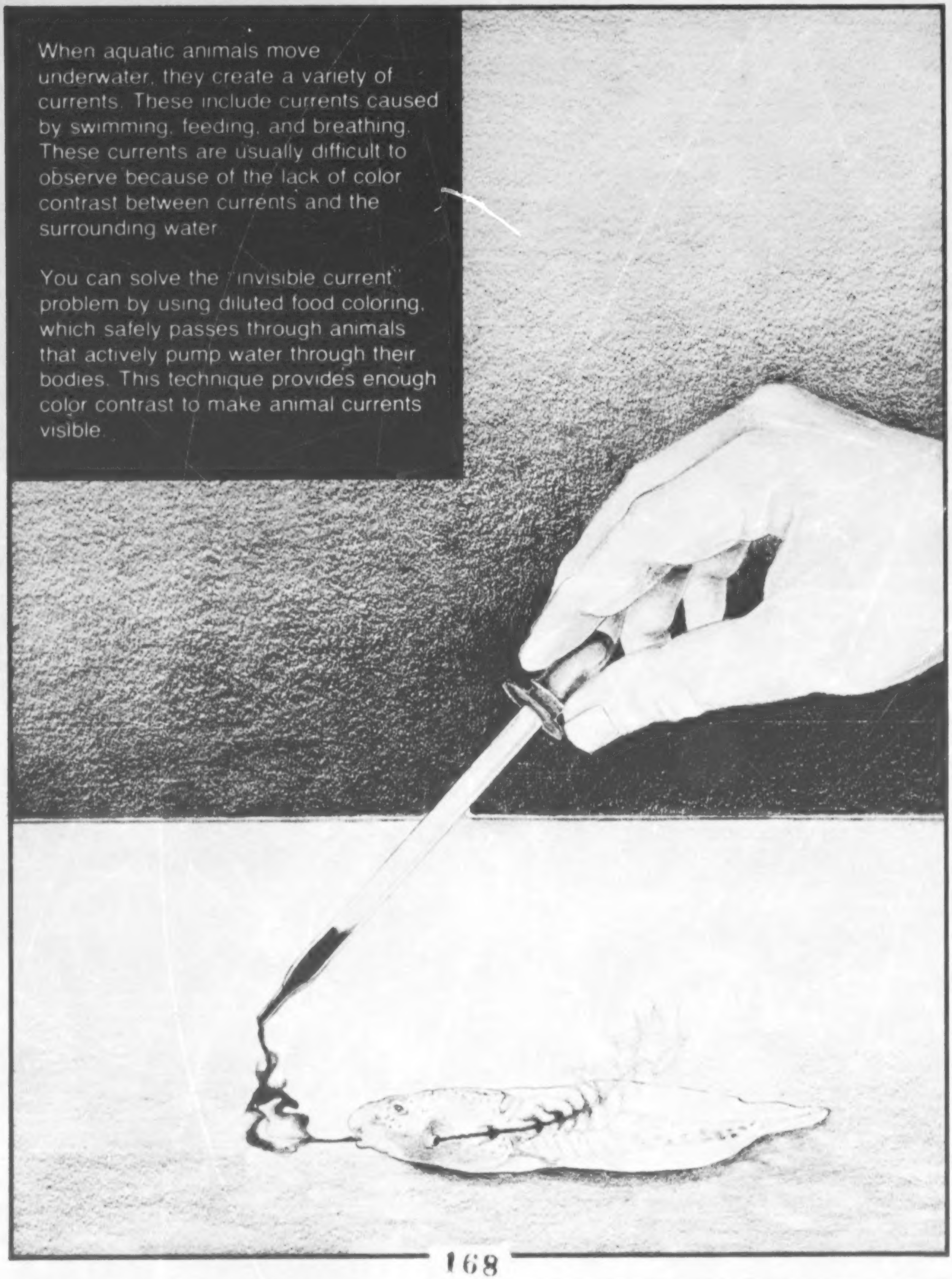
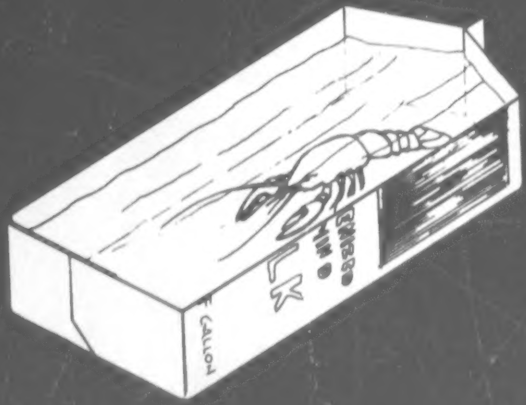
When aquatic animals move underwater, they create a variety of currents. These include currents caused by swimming, feeding, and breathing. These currents are usually difficult to observe because of the lack of color contrast between currents and the surrounding water.

You can solve the "invisible current" problem by using diluted food coloring, which safely passes through animals that actively pump water through their bodies. This technique provides enough color contrast to make animal currents visible.



INVESTIGATE CURRENTS THAT AQUATIC ANIMALS CREATE WHEN THEY BREATHE, FEED, AND PROPEL THEMSELVES THROUGH WATER.

In this activity, each participant places an aquatic animal (fresh or salt water) in a container filled with clear water and, with the aid of a medicine dropper and colored water, searches for breathing, swimming, feeding, and other currents caused by aquatic animals. Further investigations involve testing the responses of an aquatic animal to other organisms and non-living objects taken from the animal's environment. Following these investigations, introduce the term adaptation. An adaptation is any special feature of an organism that enables it to survive and reproduce in a particular area. The activity closes with the participants considering adaptations they would need to live underwater.



MATERIALS

For each kid:

1 medicine dropper
4 dropperfuls of diluted food coloring (1 part food coloring to 8 parts water) in a small container (paper cup, film canister, etc.)
1 white-bottomed container (milk-carton half, cut lengthwise)

Optional:

1 bug box (hand lens)

For the group:

1 large bucket of clear water (fresh or salt water, depending on source of your organisms)
• an assortment of aquatic animals
3-4 dipnets and spoons for transferring aquatic animals
2 small bottles of food coloring (blue, green, or red)

Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

If you cannot collect aquatic animals beforehand, you will need enough dipnets for your group to catch the animals at the beginning of the activity. Divide your activity period into two parts: a twenty-minute aquatic-animal search and, with the nets put away, *Water Breathers*.

WATER BREATHERS

PREPARATION

1. Collect a variety of aquatic animals before the activity (day or night before). Also collect some plants and non-living objects from the aquatic animal's environment. If possible, collect enough aquatic animals to allow the participants to investigate more than one kind of animal. To keep your animals fresh and lively, keep them in uncovered containers with lots of water. If you use jars, use wide-mouthed ones.
2. Dilute the food coloring before-hand; mix one part food coloring with eight parts water from the collection site. Mix up about 100 ml.

ACTION

1. Tell the participants that many aquatic animals create a variety of water currents when they breathe, feed, and swim, and that these currents are usually difficult to observe. (Refer to cover information.)
2. Introduce the medicine dropper and diluted food coloring as tools for observing aquatic-animal currents.
3. Place an active aquatic animal (fish, tadpole, shrimp, etc.) in a container filled with clear water and demonstrate the tracing technique. (See cover picture.) Emphasize the fact that only one carefully placed drop at a time is needed. Place the tip of the medicine dropper underwater and close to the area (mouth, tail, side, etc.) of the animal being investigated before squeezing the bulb.
4. Hand out the materials and let the kids choose an aquatic animal to investigate.
5. Challenge the group to use the medicine-dropper technique to search for currents caused by breathing, feeding, and swimming movements of aquatic animals.
6. As they begin, stress the focus of the activity by challenging the kids to discover as much as they can about the currents their animals create, especially breathing currents.
7. Grab a medicine dropper and some "mystery" solution and investigate some currents yourself. Help refill the viewing containers with clear water when they need it. (Be careful not to lose the aquatic animals during refilling.) Some children do not administer the dye to any body part other than the head. Encourage the kids to apply the dye near other parts of the animal.
8. After about thirty minutes, challenge the participants to investigate their animals' reactions to other organisms and non-living objects taken from the same environment.
9. Encourage the kids to investigate several aquatic animals.

CURRENT THOUGHTS

☐ Which animals seem to breathe water, i.e., pump water in and out of their bodies?

☐ Do any of the animals take in or expel water from areas other than their mouths? Which animals? Where do these intakes and exhausts occur?

☐ How do the animals circulate water?

☐ How might movement help an animal survive? (Food, oxygen, warmth, protection, etc.). Tell the kids that special features of an organism (such as gills for breathing or a powerful tail for fast swimming) that improve its chances of survival and reproduction are called **adaptations.**

☐ What adaptations would you need to live underwater? (Mechanical devices such as scuba are not allowed.)

WHAT TO DO NEXT

	Set
Attract a Fish	*II*
Hopper Circus	*II*
A Better Fly Trap	*II*
Who Goes There?	*I*

Outdoor Biology
Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

Jan. 1979 OBIS Equipment Order Form*

***About June, 1979, Delta Education, Box M, Nashua NH 03061 will distribute these and other OBIS materials. Contact them for prices and ordering information.**

Shipping Address (Please print):

Name: ____________________ **Date:** ____________________

Address: ____________________

City: ____________________ **State:** ____________________ **Zip:** ____________________

Please send me the following items in the quantities indicated:

QUANTITY	ITEM — DESCRIPTION		UNIT SHIPPING WT. (Kg.)	TOTAL WT. (Kg.)	UNIT PRICE	TOTAL PRICE
	Blacklight bulb for safari lamp	each	05		$8.97	
	Blacklight fluorescent tracing powder	20 gr. pkg	10		95	
	Blueprint paper (22 cm x 30 cm sheet)	25 sh. pkg	.20		1.75	
	Bug box	each	01		35	
	Colbat chloride crystals	110 gr. pkg	15		3.75	
	Colbalt chloride test paper (1 cm x 15 m roll)	each	.025		3.50	
	Colored cellophane (25 cm x 30 cm sheet)	red, each	.025		1.25	
		green, each	.025		1.25	
		blue, each	.025		1.25	
	Confectioners dye (10 grams in vial)	each	.020		1.00	
	Kodak Studio Proof F paper (20 cm x 25 cm sheet)	10 sh. pkg	15		2.75	
	Line level	each	.025		1.40	
	Litter Critter Wheels thermofax transparencies	1 set of 4 wheels	050		.35	
	Magnifying lens (3 lenses: 3x, 5x, 8x, plastic frame)	each	025		1.00	
	Meter tape	each	025		.50	
	Ozalid paper (21.5 cm x 28 cm sheet)	25 sh. pkg	15		1.00	
	Plastic measuring cup (250 ml)	each	020		.30	
	Plastic vials with lid (14 dram)	pkg. of 10	150		1.30	
	Spring scale (2000 gram)	each	07		3.00	
	Thermometer, calibrated in °C	each	025		1.25	
	Tweezers	each	1		40	
	Water Breathers dropper	each	010		.20	
	OBIS Lawn Guide	each	05		60	
	OBIS Pond Guide	each	05		60	
	OBIS Trial Edition, Set I	each	1.20		8.50	
	OBIS Trial Edition, Set II	each	1.20		9.50	
	OBIS Trial Edition, Set III	each	1.20		10.50	
	OBIS Trial Edition, Set IV	each	1.20		11.50	
	The OBIS Trail Module	each	05		2.00	

Subtotal Wt. (Kg.) **Subtotal**	
California sales tax for California residents only: (6% California residents) (6½% Bart County residents)	
Shipping fee (see reverse)	
TOTAL DUE	

☐ Check or money order enclosed.
Make check payable to:
Regents of the University of California

☐ Please bill me. (Minimum order: $10.00)

SEND YOUR ORDER TO: Discovery Corner — OBIS
Lawrence Hall of Science
University of California
Berkeley, California 94720

☐ Please check here if you desire air mail shipment.
OTHERWISE ALLOW FOUR WEEKS FOR DELIVERY.
(Air mail takes approximately one week.)

PLEASE RECHECK YOUR COMPUTATIONS AND BE SURE THAT THE SHIPPING FEE IS CORRECT.

Rec'd on ____________ By ____________ Shipped on ____________ By ____

To Determine Your Shipping Fee:

1. **Total the weight of merchandise.**
2. **Use Table A to find your shipping zone.**
3. **If you desire surface shipment, find the shipping charge in Table B. Allow at least four weeks for delivery.**
4. **If you prefer faster (1 week or less) airmail shipment, check the box on the front of this form, and find the shipping fee in Table C.**
5. **Enter the shipping fee in the appropriate box on the front of this form.**

Table A — Shipping Zone

Zip Code Prefixes	*Zone*	*Zip Code Prefixes*	*Zone*	*Zip Code Prefixes*	*Zone*	*Zip Code Prefixes*	*Zone*	*Zip Code Prefixes*	*Zone*	*Zip Code Prefixes*	*Zone*
006-098	8	530-534	8	674-679	6	770-787	7	850-859	5	955	3
		535-540	7	680-681	7	788	6	860-864	4	956-959	2
100-199	8	541-543	8	683-693	6	789	7	865-880	5	960-961	3
		544-567	7			790-797	6	881-882	6	962-966	1
200-299	8	570-577	6	700-704	8	798-799	5	883	5	967-969	8
		580-582	7	705-706	7			884	6	970-974	4
300-379	8	583-588	6	707-708	8	800-826	5	890-893	4	975-976	3
380-381	7	590-591	5	710-729	7	827	6	894-897	3	977-979	4
382-385	8	592-593	6	730-739	6	828-832	5	898-899	4	980-985	5
386-387	7	594-599	5	740-745	7	833	4			986	4
388-399	8			746	6	834-835	5	900-928	4	987-992	5
		600-609	8	747	7	836-837	4	930-935	3	993	4
400-499	8	610-617	7	748	6	838	5	936-939	2	994	5
		618-619	8	749-762	7	840-844	4	940-951	1	995-997	8
500-508	7	620-667	7	763-764	6	845	5	952-953	2	998	7
510-511	6	668-672	6	765-767	7	846-847	4	954	1	999	6
512-528	7	673	7	768-769	6						

Table B — Surface Shipment

WEIGHT UP TO:		**.5 Kg.**	**1 Kg.**	**2 Kg.**	**4 Kg.**	**6 Kg.**	**8 Kg.**	**10 Kg.**	**12 Kg.**	**14 Kg.**
YOUR ZONE	1-3	1.50	1.50	1.50	1.75	2.00	2.25	2.50	2.75	3.00
	4-6	1.50	1.50	1.75	2.25	2.75	3.25	4.00	4.50	4.75
	7-8	1.75	2.00	2.50	3.25	4.50	5.50	6.50	7.75	8.75

WEIGHT UP TO:		**16 Kg.**	**18 Kg.**	**20 Kg.**	**22 Kg.**	**24 Kg.**	**26 Kg.**	**28 Kg.**	**30 Kg.**
YOUR ZONE	1-3	3.25	3.50	4.00	4.25	4.50	5.00	5.50	6.00
	4-6	5.50	6.00	6.50	7.25	7.25	8.00	8.50	8.75
	7-8	10.00	11.00	12.00	13.00	14.00	15.00	16.50	17.25

Table C — Air Mail Shipment

WEIGHT UP TO:		**.5 Kg.**	**1 Kg.**	**2 Kg.**	**3 Kg.**	**4 Kg.**	**6 Kg.**	**8 Kg.**	**10 Kg.**	**12 Kg.**
ZONE	1-3	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	11.00
	4	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	11.00
	5	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	12.00
	6	2.50	3.00	3.75	4.50	5.75	7.75	10.75	11.75	14.00
	7	2.50	3.00	3.75	4.50	5.75	7.75	10.75	13.00	15.00
	8	2.75	3.25	4.25	5.25	7.25	9.00	12.00	14.25	17.00

WEIGHT UP TO:		**14 Kg.**	**16 Kg.**	**18 Kg.**	**20 Kg.**	**22 Kg.**	**24 Kg.**	**26 Kg.**	**28 Kg.**	**30 Kg.**
ZONE	1-3	13.25	15.25	17.00	19.00	21.00	21.00	25.00	27.00	29.00
	4	13.25	15.25	17.00	19.00	21.00	22.00	27.00	27.00	29.00
	5	13.25	15.25	19.00	20.00	22.00	24.00	29.00	30.00	31.00
	6	16.00	19.00	22.00	22.00	25.00	27.00	30.00	32.00	34.00
	7	16.00	20.00	24.00	25.00	28.00	30.00	33.00	35.00	38.00
	8	20.00	22.00	26.00	27.00	31.00	33.00	37.00	43.00	44.00

OBIS ABSTRACT

What is OBIS?

Start with a group of young people in the out-of-doors and a biological concept or process as the basic ingredients. Add a large measure of fun; stir in the discovery approach; and season with a simulation, a game, a craft, or an interesting investigation. Mix thoroughly and you have one of the 100 activities that have been developed by the Outdoor Biology Instructional Strategies (OBIS) Project.

OBIS provides community-sponsored youth organizations and schools with learning activities for use at common outdoor sites such as lawns, local parks, city lots, neighborhood streams and ponds, and the seashore. Although the activities are intended primarily for ten- to fifteen-year-old youngsters, both younger and older people (including family groups) have enjoyed OBIS activites. Their easy-to-follow format, simple preparation and equipment, and short duration (usually one hour) make OBIS activities suitable for both the experienced outdoor-education leader and the first timer with no previous experience in biology. The activities may be used independently or sequenced to create a program to suit your needs. Scouts, Park and Recreation districts, religious groups, service groups, nature centers, summer camps, and schools are a few of the groups that have used OBIS activites in their outdoor-education programs. OBIS activities help youngsters and adults to better understand and appreciate the ecological relationships in their local environment.

How Were OBIS Activities Developed and Trial Tested?

The OBIS materials were developed at the Lawrence Hall of Science, University of California, Berkeley, and supported by a grant from the National Science Foundation. The materials were developed over a six-year period ending in 1978. Unlike many development projects, OBIS considered the testing of activities with youngsters to be an integral part of the development process. The OBIS activity development procedure is one of devising a strategy, trying it out numerous times with youngsters, making modifications and then retrying the revised activity. This testing, revision, and retesting process was repeated on a local level and, in many cases, on a national level for each OBIS activity. To help gather national feedback on the trial edition activities, OBIS established a network of OBIS Resource Centers across the country. Over the past five years, OBIS has received thousands of feedback comments from OBIS users throughout the United States. This feedback is being used to revise the existing OBIS trial editions.

The OBIS Trial Editions are available through the Lawrence Hall of Science, University of California, Berkeley, California 94720.